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FRUIT FLIES OF THE GENUS DACUS SENSU LATIORE (DIPTERA) FROM THE PHILIPPINE ISLANDS

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TWO PLATES

In his paper of 1882 on the Philippine Diptera, Osten-Sacken [1] recorded only two species of *Dacus* from the Islands. One of these, *Dacus icarus* O.-S., is a trypaneid belonging to the very different genus *Callistomyia* Bezzi, 1913. The other, "*Dacus ferrugineus* (Wied.) Macq.," is evidently a complex of several species of the true genus *Dacus sensu latiore,* which may belong to one or another of the forms here now distinguished under the names of *Chaetodacus dorsalis, C. occipitalis, C. pedestris, C. limbiferus, C. scutellinus,* and *C. pubescens.*

In my studies on Philippine Diptera I,[2] the following four species are recorded: *Chaetodacus caudatus* Fabr., *C. cucurbitae* Coq., *C. ferrugineus pedestris* Bezzi, and *Monacrostichus citricola* Bezzi; to which I subsequently added [3] *Chaetodacus scutellinus* Bezzi, *Mellesis pedunculata* Bezzi, and *M. nummularia* Bezzi.

Through the kindness of Prof. C. F. Baker, of the University of the Philippines, Los Baños, and of Mr. R. C. McGregor, of the Bureau of Science, Manila, I have received rich material of fruit flies of the genus *Dacus sensu latiore,* from the Philippine Islands. With this material at hand, we now have a better knowledge of the systematic relationships and of the distribu-

[1] Ber. Ent. Zeitschr. 26 (1882) 83–120 and 187–252; vide 224–226.
[2] Philip. Journ. Sci. § D 8 (1913) 305–332; vide 321–324.
[3] Bull. Ent. Research 7 (1916) 99–121; vide 113, 115.

tion of these flies, which, notwithstanding their immense economic importance, are still imperfectly known for the Oriental fauna.

I have already indicated [4] the main characters of the Oriental Dacinæ in opposition to those of the Ethiopian Region. I will attempt here to give an idea of the Philippine Dacinæ in relation to those of the rest of the Oriental Region. For this purpose I will give an enumeration of the Dacinæ known from three countries that have been most intensively investigated on this subject.

A. DACINÆ FROM INDIA, BURMA, AND CEYLON; 26 SPECIES

Dacus longistylus Wied.
Dacus brevistylus Bezzi.
Dacus asiaticus Silvestri.
Chaetodacus ferrugineus Fabr.
Chaetodacus ferrugineus dorsalis Hend.
Chaetodacus ferrugineus incisus Walk.
Chaetodacus ferrugineus versicolor Bezzi.
Chaetodacus zonatus W. W. Saund.
Chaetodacus tuberculatus Bezzi.
Chaetodacus correctus Bezzi.
Chaetodacus duplicatus Bezzi.
Chaetodacus diversus Coq.
Chaetodacus maculipennis Dol.
Chaetodacus hageni de Meij.
Chaetodacus diversus Coq.
Chaetodacus caudatus Fabr.
Chaetodacus garciniae Bezzi.
Chaetodacus scutellarius Bezzi.
Chaetodacus biguttatus Bezzi.
Chaetodacus bipustulatus Bezzi.
Chaetodacus scutellaris Bezzi.
Mellesis sphaeroidalis Bezzi.
Mellesis brachycera Bezzi.
Mellesis crabroniformis Bezzi.
Mellesis destillatoria Bezzi.
Mellesis eumenoides Bezzi.

B. DACINÆ FROM JAVA; 14 SPECIES.

Bactrocera umbrosa Fabr.
Bactrocera albistrigata de Meij.
Chaetodacus impunctatus de Meij.
Chaetodacus obscuratus de Meij.
Chaetodacus dorsalis Hend.
Chaetodacus apicales de Meij.
Chaetodacus hageni de Meij.
Chaetodacus caudatus Fabr.
Chaetodacus cucurbitae Coq.
Chaetodacus maculipennis Dol.
Chaetodacus limbipennis Macq.
Chaetodacus ritsemae Wey.
Mellesis longicornis Wied.
Mellesis conopoides de Meij.

C. DACINÆ FROM FORMOSA; 9 SPECIES

Chaetodacus cilifer Hend.
Chaetodacus caudatus nubilus Hend.
Chaetodacus ferrugineus dorsalis Hend.
Chaetodacus scutellatus Hend.
Chaetodacus synnephes Hend.
Chaetodacus cucurbitae Coq.
Chaetodacus parvulus Hend.
Chaetodacus sp. *a* Hend.
Chaetodacus sp. *b* Hend.

D. DACINÆ FROM THE PHILIPPINES; 23 SPECIES

Bactrocera umbrosa Fabr.
Chaetodacus atrichus sp. nov.
Chaetodacus atrichus davaoanus var. nov.
Chaetodacus ablepharus sp. nov.
Chaetodacus ablepharus mindanaus var. nov.
Chaetodacus ferrugineus dorsalis Hend.
Chaetodacus ferrugineus occipitalis var. nov.
Chaetodacus ferrugineus pedestris Bezzi.

[4] Bull. Ent. Research 6 (1915) 85–101; vide 85, 86.

Chaetodacus ferrugineus limbiferus var. nov.
Chaetodacus continuus sp. nov.
Chaetodacus mcgregori sp. nov.
Chaetodacus bakeri sp. nov.
Chaetodacus cucurbitae Coq.
Chaetodacus caudatus Fabr.
Chaetodacus mundus sp. nov.
Chaetodacus tetrachaetus sp. nov.
Chaetodacus scutellinus Bezzi.
Chaetodacus pubescens sp. nov.
Mellesis subsessilis sp. nov.
Mellesis bioculata sp. nov.
Mellesis pedunculata Bezzi.
Mellesis nummularia Bezzi.
Monacrostichus citricola Bezzi.

From the above enumerations it is to be seen that *Chaetodacus dorsalis, C. cucurbitae,* and *C. caudatus* are common to the four countries; while *C. maculipennis* and *C. hageni* are common to India and Java, and *Bactrocera umbrosa* is common to Java and the Philippines. Of the three widely spread species *C. f. dorsalis* is the commonest representative of the *ferrugineus* group, which is the eminently characteristic *Chaetodacus* from the Orient; *C. cucurbitae* and *C. caudatus* are widely distributed over the region as well as over the islands of the Pacific Ocean, probably in connection with man and commerce. The other species are in great probability endemic; but even among these attention must be given to the forms spread by man.

The descriptions of the following species have been carefully compared, but have been found different:

frauenfeldi Schiner, 1868, from the Stuart Islands.
xanthodes Brown, 1904, bred in New Zealand from fruits of various kinds imported from Fiji.
cucumis French, 1907, bred in New South Wales from cucumbers imported from Queensland.
ornatissimus Froggatt, 1909, bred at Sydney, New South Wales, from mandarins imported from New Caledonia.
curvipennis Froggatt, 1909, bred at Sydney, New South Wales, from bananas imported from Fiji.
aequalis Coquillett, 1909, bred from larvæ in oranges at Gosford, New South Wales.
melanotus Coquillett, 1910 (=*rorotangae* Froggatt, 1910), bred from mangoes in the Cook Islands.
facialis Coquillett, 1910, bred from guavas in the Tonga Islands.
virgatus Coquillett, 1910, bred from guavas in the Tonga Islands.
pepisalae Froggatt, 1910, from the Solomon Islands.
passiflorae Froggatt, 1910, bred from mangoes in Fiji.
tongensis Froggatt, 1910, bred from mangoes in the Tonga Islands.
kirki Froggatt, 1910, bred from peaches and other fruits imported into New Zealand.
froggatti nom. nov. for *zonatus* Froggatt, 1910 (not of W. W. Saunders, 1841), from Solomon and Murray Islands.
chrysotoxus Hendel, 1912, from Key Island.

Most of the very numerous species of *"Dacus"* described by Walker from the Malay Archipelago belong to other genera of

the Trypaneidæ or of the Ortalidæ;[5] it seems that the following only may properly belong to *Chaetodacus:*

discipennis Walker, 1861, from Batjan; seems to be near *chrysotoxus* Hend.

terminifer Walker, 1860, from Macassar; closely allied to *cilifer* Hend. and to *ablepharus* Bezzi.

diffusus Walker, 1860, from Macassar; seems to be allied to *maculipennis* Dol.

emittens Walker, 1860, from Celebes; seems to belong to the *ferrugineus* group.

absolutus Walker, 1861, from Ceram; seems to be allied to *ferrugineus* Fabr.

expandens Walker, 1859, from the Aru Islands, seems to be very near *ferrugineus* Fabr.

pectoralis Walker, 1859, from Aroe, Batjan, and Waigoe; seems to be closely allied to *ferrugineus* Fabr.

As an example of the richness and the great variety of the Philippine fauna in *Dacus* species, it may be recorded that on the small island of Batbatan,[6] Antique Province, Panay, Mr. McGregor procured in a single collection, consisting of thirty specimens, no less than eight forms of *Chaetodacus,* seven of which are new to science, as follows:

Chaetodacus atrichus sp. nov., 2 males and 1 female.
Chaetodacus ferrugineus occipitalis var. nov., 6 males and 1 female.
Chaetodacus ferrugineus pedestris Bezzi, 2 females.
Chaetodacus ferrugineus limbiferus var. nov., 2 males and 5 females.
Chaetodacus continuus sp. nov., 1 female.
Chaetodacus mcgregori sp. nov., 1 male and 1 female.
Chaetodacus mundus sp. nov., 6 males.
Chaetodacus tetrachaetus sp. nov., 2 males.

The genera of the true Dacinæ at present known can be distinguished with the aid of the following key which is a complement of that already given by me.[7] It must be remarked

[5] See my critical enumeration, Memoirs Ind. Mus. 3 (1913) 65–84.

[6] Batbatan Island lies 16 kilometers west of Culasi Point and has an area of about 770 hectares. The shores are precipitous coral rock, and there are few landing places. Nearly the entire island is 10 to 20 meters above the sea; the highest point has an elevation of about 120 meters. The soil is everywhere poor and thin. Considerable rice and a few coconuts and bananas are cultivated; the native vegetation is scanty and consists of plant species that are common on Panay. The flies described in this paper as from Batbatan Island were caught in the small town at the flowers of hedges of *Jatropha curcas* Linn., during a week of typhoon weather, June 24 to 30, 1918. Doctor Bezzi has requested me to add this note.—McGregor.

[7] Philip. Journ. Sci. § D 8 (1913) 323.

that the genera *Dacus sensu stricto, Tridacus, Tetradacus,* and *Callantra* have not yet been found in the Philippine Islands.

a^1. Antennæ as long as face or only a little longer, carried very near the face and with first joint not elongate, even shorter than second; face hollowed in the middle; abdomen not properly stalked, though sometimes a little constricted at base; second basal cell short, usually not more than twice as long as broad.

b^1. Thorax without prescutellar bristles; scutellum with a single pair of bristles, the basal one being always wanting.

c^1. Wings of male without supernumerary lobe at end of anal vein.

d^1. Thorax with only two supra-alar bristles, the anterior one being quite wanting; abdomen often with no distinct segmentation along middle line; anal brown stripe of wings less developed or wanting; Mediterranean or Ethiopian species..... **Dacus s. s.**

d^2. Thorax with three or four supra-alar bristles, the anterior ones well developed; abdomen as a rule with free segments on the middle.

e^1. Thorax with but one anterior supra-alar bristle; anal brown stripe of wings usually well developed; ovipositor not peculiarly swollen at base; Ethiopian..... **Tridacus Bezzi.**

e^2. Thorax with two anterior supra-alar bristles; no anal stripe on wings; ovipositor greatly swollen, bottle-shaped at base; Japanese ..... **Tetradacus Miyake.**

c^2. Wings of male with a well-developed supernumerary lobe; abdominal segments free; anal brown stripe of wings well developed; Oriental..... **Chaetodacus p. p.**

b^2. Thorax always provided with prescutellar and with anterior supra-alar bristles; scutellum sometimes with two pairs of bristles, the basal pair often present; wings of male, as a rule, with a well-developed supernumerary lobe; Oriental.

f^1. Wings adorned with transverse, fuscous bands. **Bactrocera Guér.-Mén.**

f^2. Wings not banded..... **Chaetodacus Bezzi.**

a^2. Antennæ much longer than face, carried far apart from it and with the first joint usually elongate, as long as second; face not or little hollowed, usually flat or even convex; abdomen typically stalked, club-shaped; thorax without prescutellar bristles; femora sometimes spinose beneath; wings with second basal cell more elongate, usually many times longer than broad, and without supernumerary lobe in the male; Oriental.

g^1. Basal joints of antennæ wholly separated.

h^1. Face flat or even a little concave; thorax with transverse suture broadly interrupted in the middle and destitute of unpaired acrostical bristles; front femora not spinose beneath or very rarely so; second portion of fourth longitudinal vein straight, the discoidal cell being less narrowed at base..... **Mellesis Bezzi.**

h^2. Face distinctly convex; thorax with transverse suture not interrupted and often with a strong acrostical bristle on the middle line; front femora with some spines beneath near the end; second portion of fourth

vein deeply sinuous, the discoidal cell being thus much narrowed on the basal half..... Monacrostichus Bezzi.

g^2. Basal joints of antennæ united in the shape of a common petiole..... Callantra Walk.[8]

The first three genera, as far as known, are not represented in the Philippines. *Dacus* and *Tridacus* are not Oriental; the two species of true *Dacus* found in India (*longistylus* Wied. and *brevistylus* Bezzi) are evidently of African origin; *Dacus asiaticus* Silvestri [9] is only a variety of the Mediterranean *D. oleae* Gmelin; but the presence of true Oriental forms lacking prescutellar bristles is demonstrated by the two Philippine species described below; and moreover by the recently described *Tetradacus tsuneonis* Miyake,[10] from Japan, as well as by the Australian *Dacus cucumis* French, which lacks also the anterior supra-alar bristle.

The Philippine species without prescutellar bristles (*atrichus* and *ablepharus*), are evidently more closely allied to *Chaetodacus* than to *Tridacus*, as shown by their sexual wing dimorphism, and by their close affinity with *cilifer* Hendel, which has well-developed scutellar bristles. They have no close affinity with the African species of *Dacus sensu stricto*, like *annulatus*, *mochii*, *blepharogaster*, *erythraeus*, etc., which usually have a nonciliated third abdominal segment in the male and are likewise prevalently black and of a rather small size, but all have no anterior supra-alar bristle, partly fixed abdominal segments, and no brown anal stripe on the wings. A possibility of an African origin for these Philippine species seems thus to be excluded.

I. Genus BACTROCERA Guérin-Méneville (1830) 1838

It seems that, for practical purposes, it is still convenient to keep the species with banded wings separate from those with nonbanded wings and thus the following genus is maintained here as distinct; but if the two species with a single crossband on the wings (*frauenfeldi* Schiner and *albistrigata* de Meijere) are placed in the present genus, and if the recently discovered African species of *Dacus sensu stricto* with partly banded wings (*hamatus* Bezzi and *trigonus* Bezzi) are taken into consideration, the separation of the two genera seems to be very doubtful.

[8] The genus *Diplochorda* Osten-Sacken, 1880, placed in the Dacinæ by Hendel, 1911, and by Edwards, 1915, is now considered as belonging to the Phytalmiidæ by Hendel himself, Wien. ent. Zeitung 33 (1914) 74, note.

[9] Atti R. Accad. dei Lincei, Roma V 25 (1916) 425.

[10] Bull. Imp. Central Agr. Exp. Sta. Japan 2 (1919) 92, pl. 2, fig. 1.

1. Bactrocera umbrosa Fabricius, 1805.

Of this widely spread Oriental species, which I have selected as the type of the genus *Bactrocera sensu stricto*, there are specimens from the following localities: LUZON, Laguna Province, Mount Maquiling (*C. F. Baker*). MINDANAO, Butuan and Davao (*Baker*).

The species has been described several times under different names, of which *Dacus fascipennis* Wiedemann, 1819, from Java; *Bactrocera fasciatipennis* Doleschall, 1856, from Java; and *Strumeta conformis* Walker, 1857, from Singapore, are commonly considered as synonyms; but even *Dacus frenchi* Froggatt, 1909, from New Caledonia and Australia, is certainly the same species, in as much as Froggatt [11] records later that it was bred in Java from fruits of *Artocarpus integrifolia* by Roepke.

Another question is that concerning the original *Bactrocera longicornis* of Guérin-Méneville (1830) 1838; in 1835 Macquart gave a figure of the wing that is very different from the wing of *umbrosa*, showing the two middle dark bands confluent toward the hind border of the wing; moreover, the scutellum is described as having a black spot above in the middle.

II. Genus CHAETODACUS Bezzi, 1913

The rather numerous Philippine species of *Chaetodacus* can be distinguished as follows:

*a*¹. Third and fourth abdominal segments entirely black or each with a complete and broad, transverse black band; no middle longitudinal black stripe on these segments; oval patches of last segment black; occiput black, with a narrow yellow border; species of smaller size.

*b*¹. No prescutellar bristles; third abdominal segment of male not ciliated.

*c*¹. Abdomen reddish, with three complete black crossbands; black oval patches of last segment very striking, contrasting with the reddish color of the surrounding parts.

*d*¹. Frons black-spotted; face of male entirely black; face of female with three black spots, the upper one placed just below root of antennæ of smaller size..... C. atrichus sp. nov.

*d*². Frons unspotted; face of female with the two lower black spots alone; of greater size..... C. davaoanus var. nov.

*c*². Abdomen entirely black, even the black oval patches of the last segment being indistinguishable.

*e*¹. A well-developed black crossband at vertex; face in both sexes with a broad black band on lower half.
C. ablepharus sp. nov.

*e*². Black vertical band less distinct or even wanting; face of female with two black spots..... C. mindanaus var. nov.

[11] Proc. Linn. Soc. N. S. W. 35 (1910) 866.

b^2. Prescutellar bristles well developed; third abdominal segment of male ciliated; face of male with two black bands, that of female with two black spots..... C. cilifer Hend.[12]

a^2. Fourth abdominal segment without complete black crossband or, rarely, with a very narrow one; last two segments of abdomen with a black longitudinal middle stripe; oval patches of last abdominal segment never black; species of greater size.

f^1. Scutellum with but a pair of bristles, the apical one.

g^1. Two pairs of lower fronto-orbital bristles; hind cross vein not broadly margined with fuscous; mesonotum without a bright yellow postsutural middle stripe.

h^1. Costal dark border of wing not much dilated at end and not reaching fourth vein apically; frons narrow; third abdominal segment of male ciliated (in one species the male is unknown).

i^1. Face with the usual two black spots; no anal bulla on wings.

j^1. Yellow lateral stripes of mesonotum broadly interrupted before suture; anal brown stripe of wings well developed.

k^1. Vertical, thoracic, and scutellar bristles pale yellowish; occiput reddish; mesonotum partly reddish on breast and on pleura; mesophragma reddish in the middle; femora and tibiæ entirely reddish; costal border of wings narrow and rather pale..... C. dorsalis Hend.

k^2. The above-named bristles more or less darkened or even blackish; mesonotum and mesophragma entirely black; tibiæ black, at least those of hind pair of legs; costal border broader and more intensely black.

l^1. Costal border toward middle not extending beyond second longitudinal vein or only a little so, the submarginal cell being in greatest part hyaline or only yellowish.

m^1. Occiput reddish, with more or less distinct fuscous spots in the middle; femora entirely yellowish or only those of front pair of legs darkened at end on the outer side; submarginal cell often yellowish below costal border; of greater size.

C. occipitalis var. nov.

m^2. Occiput black in the middle, with reddish borders; all femora more or less blackened at ends; submarginal cell quite hyaline below costal border; of smaller size.

C. pedestris Bezzi.

l^2. Costal border extending to third longitudinal vein, submarginal cell being thus filled entirely

[12] From Formosa, included here for comparison only.

with brown; occiput usually reddish; femora blackened at ends; size as in *occipitalis*.

C. limbiferus var. nov.

j^2. Yellow lateral stripe of mesonotum extending, without interruption, from humeri to postalar calli; anal brown stripe of wings less developed; frons narrow and unspotted; bristles black; costal border rather dilated at end, but not extending in the middle beyond second longitudinal vein.

C. continuus sp. nov.

i^2. Face unspotted; no brown anal stripe, but in male a peculiar anal bulla on wing; frons narrow and unspotted; bristles black; costal border narrow and not dilated at end..... C. mcgregori sp. nov.

h^2. Costal border narrow, but suddenly dilated at end to form a broad apical spot, which reaches below fourth vein; frons unspotted and broad, about as broad as long; anal stripe developed; third abdominal segment of male not ciliated..... C. bakeri sp. nov.

g^1. Three pairs of lower fronto-orbital bristles; mesonotum reddish, with a bright yellow middle stripe beyond the suture; hind cross vein broadly margined with fuscous.

C. cucurbitae Coq.

f^1. Scutellum with two pairs of bristles, the basal and the apical being equally developed; mesonotum with a bright yellow, postsutural middle stripe.

n^1. Scutellum entirely yellow.

o^1. Face without black spots; hind cross vein and hind border of third posterior cell margined with fuscous; three lower orbital bristles.

C. mundus sp. nov.

o^2. Face with the usual two black spots; third posterior cell without fuscous border.

p^1. Three lower orbital bristles; anal brown stripe developed; costal border dilated at end; mesonotum reddish in front of suture.

C. caudatus Fabr.

p^2. Two lower orbital bristles only; no distinct anal stripe; costal border not dilated at end; mesonotum black in front of suture.

C. tetrachaetus sp. nov.

n^2. Scutellum with a well-defined black spot at end, between apical bristles; brown anal stripe of wings broad.

q^1. Two lower orbital bristles only; back of mesonotum black; femora

black-spotted; costal border of wings not dilated at end.
C. scutellinus Bezzi.

♀. Three lower orbital bristles; back reddish in front; femora not black-spotted; costal border dilated at end.... **C. pubescens sp. nov.**

2. Chaetodacus atrichus sp. nov. Plate I, fig. 1.

A small species, destitute of prescutellar bristles, very distinct on account of the complete black bands of the abdomen, the entirely black face of the male, and the nonciliated third abdominal segment in the same sex.

PANAY, Antique Province, Batbatan Island (*R. C. McGregor*). Types in my collection.

Male and female.—Length of body, 4.5 to 5 millimeters; of wing, 4.4 to 4.8. Occiput shining black, with a complete yellow border, which is a little dilated below. Frons about twice as long as broad; dull yellow, with rather shining, a little paler orbits; a dark middle spot and two dark spots on each side, one at the superior and one at the second of the lower orbital bristles; ocellar dot shining black and at its sides a dark spot, thus forming a more or less distinct vertical crossband; lunula small, shining reddish brown. Antennæ a little longer than face, first joint short; entirely reddish, third joint a little infuscated above and at the end; crista reddish at base. Face shining, hollowed in the middle; in the male entirely black, only the external half of antennal grooves yellowish like the linear cheeks; in the female pale yellowish, with three black spots, two near mouth border at inner end of antennal grooves and the third just below root of antennæ. Jowls narrow, reddish brown, with a small dark subocular spot. Palpi and proboscis reddish, the latter darkened above. Cephalic bristles black; only two pairs of lower orbital bristles present.

Mesonotum entirely black and rather dull on the back on account of its punctulation and its short, gray pubescence; smooth and shining on the pleura; breast with whitish hairs. Whitish yellow markings broad and disposed as follows: Humeri entirely; notopleural calli; a broad stripe on each side above root of wings, continued in front of suture with a small spot, and abbreviated behind before reaching scutellum; a broad, triangular spot on mesopleuron, which ends with a small spot on the upper part of sternopleuron; a double, contiguous hypopleural spot. Scutellum entirely whitish yellow, with only the apical pair of bristles. Mesophragma entirely black like back

of mesonotum. Thoracic bristles black; scapular bristles well developed, even the middle pair; one anterior supra-alar; no prescutellar; pteropleural a little weaker than the mesopleural. Squamulæ darkish; halteres whitish.

Abdomen broad and rounded, punctate and pubescent like back of mesonotum; yellowish, with broad, black crossbands; first segment broadly black at base and on sides; second segment with a complete transverse black band at base; third and fourth segments each with a complete, black, basal crossband, in the male equal in breadth to half the segment, in the female much broader, only a narrow hind border being yellow; fifth segment with a black fore border, interrupted in the middle and more developed in the female; black oval patches less shining on account of their punctulation, and in the female a black middle stripe between them. Venter with yellowish membrane, anterior sternites brown and posterior ones black; male genitalia black, with yellowish appendages, anterior one forked at base; ovipositor flat, with basal segment black and apical segment reddish brown; legs with blackish or dark brown coxæ and trochanters; femora yellow, with a more or less broad black patch before the end; all tibiæ yellow in the male, in the female four posterior ones black with yellowish bases; tarsi whitish in both sexes.

Wings (Plate I, fig. 1) hyaline, with a blackish fore border and a blackish anal stripe. Costal border formed by the stigma, by the black marginal cell not surpassing second longitudinal vein, and by a little broader (but not spotlike) border at end of submarginal cell and of first posterior cell, ending a little beyond middle of apex of first posterior cell. Anal stripe broad and intensive, but not dilated at end, and bearing no bulla in the male. First basal cell darkened just above dilated second basal cell. Last portion of fourth vein nearly straight.

Note.—In the abdominal pattern the present species recalls *Chaetodacus scutellatus* Hendel, from Formosa, or *C. bezzi* Miyake, from Japan, which however are much larger and have prescutellar bristles.

3. Chaetodacus atrichus davacanus var. nov.

Differing from the preceding species in greater size and in some minor details of color pattern.

MINDANAO, Davao (*Baker*). Type in Professor Baker's collection.

Female.—Length of body, 6 millimeters; of wing, 5.5. The

frons is quite unspotted, excepting the black ocellar dot; the face lacks the upper black spot; the episternal callosities are broadly yellowish; the black abdominal band lacks the middle point on that of the third segment, and there is no black stripe between the two black patches of the last segment; the basal segment of the ovipositor is reddish brown.

4. **Chaetodacus ablepharus** sp. nov. Plate I, fig. 2.

Very much like the preceding species (*C. atrichus*), but at once distinguished by the entirely black abdomen.

LUZON, Tayabas Province, Malinao (*Baker*): Laguna Province, Mount Banahao (*Baker*). Types in Professor Baker's collection.

Male and female.—Length of body, 4.5 millimeters; of wing, 4.3. Head as in the preceding, but yellow occipital border narrower; at vertex a small but distinct transverse black band, including black ocellar dot; face in both sexes with a black crossband, extending on its lower half. Mesonotum and scutellum as in the preceding, but back distinctly more shining; supra-alar stripe narrower and ending at suture, presutural spot before it being quite wanting. Halteres whitish. Abdomen as in the preceding but completely black, only the extreme hind border at last segment being narrowly reddish in the male; male genitalia and ovipositor entirely black. Legs as in the preceding, but femora more broadly and more intensely black; posterior tibiæ blackish in the male and all tibiæ black in the female. Wings (Plate I, fig. 2) as in the preceding; marginal cell a little subhyaline in the middle, the costal border being thus even narrower, thin fringe at hind border of axillary lobe longer than in the preceding species; supernumerary lobe of the male more exaggerated.

Note.—The present species is closely allied to *Chaetodacus cilifer* Hendel, from Formosa, which, however, has prescutellar bristles and a ciliated third abdominal segment in the male. It is always a question which of the species *C. ablepharus* and *C. cilifer* may or may not be the same as *C. terminifer* Walker, from Macassar.

5. **Chaetodacus ablepharus mindanaus** var. nov.

Distinct from the species in some minor details of the pattern of the head.

MINDANAO, Davao (*Baker*). Type in Professor Baker's collection.

Female.—Differs only in the want of the black crossband

at vertex; and in the face, which has only two black spots, of elongate shape, at the lower end of the antennal grooves.

6. Chaetodacus ferrugineus dorsalis Hendel, 1912.

This is the palest-colored form among those separated from *C. ferrugineus;* it seems to be rather rare in the Philippines, being represented by a single female specimen.

LUZON, Laguna Province, Los Baños (*Baker*).

7. Chaetodacus ferrugineus occipitalis var. nov. Plate I, fig. 3.

Male and female.—This new variety is darker colored than the preceding one, having darkened bristles, black mesonotum, black mesophragma, and black tibiæ; but it is paler colored than the following one, having reddish occiput and entirely yellowish femora. The dark fore border of the wing (Plate I, fig. 3) is broader than in *C. dorsalis* and *C. pedestris;* it is usually continued by a yellowish tint into the middle of the submarginal cell. The length varies from 7 to 8 millimeters. It seems to be the commoner form in the Philippines.

LUZON, Laguna Province, Los Baños, Mount Maquiling and Mount Banahao (*Baker*) : Rizal Province, Manila (*McGregor*). PANAY, Antique Province, Batbatan Island (*McGregor*). MINDANAO, Davao (*Baker*). Types in Professor Baker's collection. Specimens taken at Singapore by Professor Baker agree with this variety.

Note.—In all these three forms (*C. f. occipitalis, pedestris,* and *limbiferus*) the oval patches of the fifth abdominal segment are shining reddish, like the surrounding parts.

8. Chaetodacus ferrugineus pedestris Bezzi, 1913. Plate I, fig. 4.

Male and female.—In the present variety the occiput is black in the center, with a yellow border on the sides; the bristles are nearly black; the submarginal cell (Plate I, fig. 4) is quite hyaline below the costal border, which does not surpass the second longitudinal vein in the middle or only a little so. The length varies from 6 to 7 millimeters, rarely surpassing 7 millimeters in the female.

It is probable that the present form is the *ferrugineus* recorded by Osten-Sacken, being very common near Manila. It is closely allied to the common Indian form that I have described under the name *C. ferrugineus incisus* Walker, but may be distinguished by the much broader yellow supra-alar stripe of mesonotum and the less-blackened abdomen.

LUZON, Laguna Province, Los Baños (*Baker*) : Rizal Province,

Manila (*McGregor*). PANAY, Antique Province, Batbatan Island (*McGregor*).

9. Chaetodacus ferrugineus limbiferus var. nov. Plate I, fig. 5.

Male and female.—This new variety is allied to *C. pedestris* in the color of the legs and of the bristles and to *C. occipitalis* in the color of the occiput; but differs from both in the very broad black fore border of the wings (Plate I, fig. 5), which extends equally broadly to the third longitudinal vein. The length varies from 7 to 8 millimeters.

PANAY, Antique Province, Batbatan Island (*McGregor*). Types in my collection.

10. Chaetodacus continuus sp. nov. Plate I, fig. 6.

Allied to the preceding forms of *C. ferrugineus sensu latiore*, but distinct from them as well as from all the other species here recorded, on account of the yellow lateral stripe of mesonotum being continued, without interruption, from the humeri to the postalar calli.

PANAY, Antique Province, Batbatan Island (*McGregor*). Type in my collection.

Female.—Length of body, 6 millimeters; of ovipositor, 1.5; of wing 5.5. Occiput shining reddish yellow, with a less-distinct fuscous, central patch. Frons proportionately narrow, more than twice as long as broad; entirely reddish yellow, unspotted, being only a little infuscated in middle of anterior half; small ocellar dot black; shining only on sides and at vertex. Lunula reddish. Antennæ entirely reddish, as long as face; third joint as narrow as usual, infuscated at end and at upper border near the end. Face concave, shining yellowish, with two elongate black spots at apical half of antennal grooves; cheeks linear, with white dust; jowls narrower than breadth of third antennal joint, not distinctly spotted. Palpi reddish; proboscis dirty brownish. Cephalic bristles black; only two pairs of lower orbital bristles.

Mesonotum with a very characteristic pattern: On the back reddish, with a short pale yellowish pubescence; finely punctulate and rather shining at sides; along the middle two opacous, whitish longitudinal stripes, separated by a narrow darkish and shining middle streak, not extending to scutellum; along dorsocentral lines two shining black longitudinal stripes, one on each side, extending from the black collar to scutellum and united there by a shining black transverse stripe; humeri wholly yellow; supra-alar yellow stripe broad and continued in front of

suture by an equally broad, slightly arched stripe, which reaches humeral spot; a black notopleural stripe, sutural callosities yellow. Pleura shining black, reddish on propleural region; mesopleuron with a broad yellow patch, continued below with a broad rounded spot on upper part of sternopleuron; a double yellow hypopleural spot; mesophragma entirely shining black. Scutellum entirely yellow with a very narrow black basal stripe; it has only the apical pair of bristles. All the bristles black; middle scapular strong, but shorter than those of outer pair; pteropleural well developed; prescutellar long; one anterior supra-alar. Squamulæ dark, with pale hairs; halteres whitish.

Abdomen rounded, with distinct segmentation, broader than thorax, reddish, finely punctulate, rather shining, with a short pale yellowish pubescence. Whole of first and second segments narrowly black on sides and with a black transverse stripe on the middle not extending to sides; hind half of second segment, beyond the transverse black stripe, paler and more yellowish; third segment black at base and on sides, forming thus a second black crossband, the latter broadened laterally and extending to the black sides; fourth and fifth segments black on sides; a black middle stripe, very narrow at the black basal border of third segment, becoming broader on fourth and fifth segments and reaching the end of the last; fifth segment entirely shining, its usual patches not distinct. Venter entirely reddish, with black borders; ovipositor entirely reddish and shining, flattened, with basal segment a little infuscated apically. Legs and coxæ pale yellowish, with hind tarsi whitish; middle tibiæ black on basal and whitish on apical half; hind tibiæ quite black; the short pubescence of legs with the color of the parts on which it occurs; spur of middle tibiæ black.

Wings (Plate I, fig. 6) hyaline and iridescent, proportionally narrow; second longitudinal vein straight; third slightly bent downward at end; last portion of fourth vein slightly curved at base; small cross vein beyond middle of discoidal cell. Pattern very simple, consisting only of a narrow brown fore border, which includes the darker stigma, extends below not beyond second longitudinal vein, fills up the end of submarginal cell and the whole end of first posterior cell, being there rather broad with an oblique inner border and reaching the end of fourth vein. Costal cells and the part of first basal cell just above the dilated second basal cell infuscated; third posterior cell slightly infuscated at base near anal cell, but there is no distinct brown anal stripe.

11. **Chaetodacus mcgregori** sp. nov. Plate I, fig. 7.

Allied to the preceding species, but distinct by the unspotted face, and strikingly characterized by the broad third antennal joint, and by the anal bulla in the wing of the male.

PANAY, Antique Province, Batbatan Island (*McGregor*). This very peculiar species is named in honor of its collector. Types in my collection.

Male and female.—Length of body, 5 to 5.5 millimeters; of ovipositor, 0.5; of wing, 4.5 to 5. Head and its bristles exactly as described for the preceding species, but no distinct dark patch on middle of occiput. Antennæ a little shorter than face and with third joint broader than in the allied species; very broad in the male and clothed with very long pubescence, obliquely truncate at the end; entirely yellowish. Face quite unspotted. Back of mesonotum as in the preceding, but paler, the black stripes being less developed; yellow stripe uniting humeri with supra-alar stripe less marked and interrupted in front of suture. Pleura likewise colored, but propleural region more broadly reddish; mesophragma with a reddish middle stripe. Scutellum, squamulæ, and halteres as in the preceding. Bristles black, but scapular, mesopleural, and pteropleural yellowish.

Abdomen as in the preceding, but first two segments without black sides; black middle longitudinal stripe present only on the last two segments, being quite wanting on third; in the female the fourth segment with a narrow black basal band, which is wanting in the male; sides of last three segments black spotted in both sexes; oval patches of fifth segment indistinct in both sexes. Third segment of male ciliated; ovipositor very short and entirely of a pale reddish color. Legs as in the preceding, but even paler, the middle tibiæ being quite yellowish and the hind tibiæ being only darkened, not properly black.

Wings (Plate I, fig. 7) as in the preceding, but distinctly broader. Costal border equally shaped, but paler and more equal throughout, being not at all dilated at end of first posterior cell; stigma much paler; costal cell quite hyaline; first basal cell only a little infuscated above second basal one; anal stripe less indicated in the female, in the male replaced by a shining, sharply separated bulla of a yellowish color, placed just above the prolongation of the anal cell, on its terminal half. Supernumerary lobe of male not much developed.

12. **Chaetodacus bakeri** sp. nov. Plate I, fig. 8.

A rather robust species, with an almost stalked abdomen,

distinct from all the other species with two scutellar bristles on account of the broad, apical fuscous spot of the wings.

MINDANAO, Davao, a male specimen belonging to Prof. C. F. Baker, in whose honor it is named.

Male.—Length of body, 6.5 millimeters; of wing, 6. Occiput rather convex, shining yellowish, reddish toward middle. Frons very broad, about as broad as long, entirely reddish yellow, unspotted, with a blackish, transverse, vertical stripe, including the black ocellar spot; opacous. Lunula broad, yellowish. Antennæ as long as face, with a short first joint; entirely yellowish, with a narrow third joint. Face concave, shining yellow, with black spots at end of antennal grooves. Cheeks whitish; jowls as broad as breadth of third antennal joint, with a reddish subocular spot. Palpi reddish; proboscis dirty brown. Cephalic bristles black; only two lower orbital bristles.

Back of mesonotum reddish, roughly punctulate, a little shining, with a short pale pubescence; black markings as follows: A narrow middle stripe, ending at suture; a triangular patch on each side before suture, with base on dorsocentral line and vertex on notopleural line just behind humeral callosities; a broad patch on each side behind suture, reaching with its acute point the base of scutellum; a narrow transverse stripe just in front of scutellum. Pleura reddish, with broad black patches around the yellow markings. Yellow markings as follows: Humeral calli entirely; presutural calli, and extending from them a short triangular spot near suture; a narrow and less striking supra-alar stripe; a broad mesopleural stripe, continued below into a broad spot on upper part of sternopleuron; a double hypopleural spot. Mesophragma black, but reddish toward the middle and above. Scutellum convex, punctulate, yellowish, with a very narrow basal black stripe; with only the apical pair of bristles. Thoracic bristles black, but dropped out in the case of the type. Squamulæ and halteres whitish.

Abdomen very convex in the middle and restricted at base, but not properly stalked; segmentation very evident; reddish, punctulate, and pubescent like back of mesonotum; first and second segments more yellowish, and black at base and on sides, black crossband of second segment not extending to sides; third segment with black transverse band at base, dilated on a black lateral border at sides, and moreover with the narrow black longitudinal middle stripe, forming with those of fourth and fifth segments a longitudinal stripe, narrowly interrupted at sutures

and ending a little before hind border of last segment. Last two segments with a broad black patch on each side, in the shape of a lunate spot, chiefly those of the fourth segment; oval patches of fifth segment less indicated and nearly opacous. Venter entirely reddish yellow, only the pregenital plate being blackish. Hind border of third segment with black cilia on sides. Legs and coxæ reddish yellow, with tarsi whitish at base; short pubescence whitish, middle spur black; four anterior tibiæ more or less darkened outwardly and at base; hind tibiæ blackish, with a broad prominent tubercle at hind side before the end.

Wings (Plate I, fig. 8) hyaline, very iridescent and shining; veins reddish; second longitudinal vein straight, short and very close to costa, the marginal cell being as narrow as stigma; third vein rather sinuous, curved above before its end; terminal portion of fourth vein very little curved at base; small cross vein very long, placed about on middle of discoidal cell, the latter less regular than usual, being a little restricted above on its basal half; supernumerary lobe not much developed. The pattern consists of a very narrow costal border, including the stigma and the very narrow marginal cell; at distal end of this border and narrowly united with it, a very broad, rounded, blackish spot at ends of submarginal and first posterior cells. Costal cells quite hyaline, first basal darkened above the second. Anal stripe well developed, and apparently broadened at end of the joint of anal cell.

Note.—The present species, because of its broad frons, the restricted base of its abdomen, and its wing pattern, recalls some species of the genus *Mellesis* with shortened first antennal joint, like *M. brachycera* Bezzi, from India; but it seems that the anterior supra-alar bristles as well as the prescutellar bristles are present.

13. **Chaetodacus cucurbitae** Coquillett, 1899.

This is well distinguished from all the other species by the three pairs of lower orbital bristles, the middle yellow stripe of the back of mesonotum, and the peculiar wing pattern with the broadly infuscated hind cross vein.

LUZON, Laguna Province, Los Baños and Mount Maquiling (*Baker*). MINDANAO, Davao (*Baker*). These insular specimens are a little smaller than the continental ones (from India), measuring usually not over 6 to 6.5 millimeters in length.

14. **Chaetodacus caudatus** Fabricius, 1805.

The Philippine specimens of the present species are very much

like those of the preceding one, but they are at once distinguished by the larger size, the black patches of the back of mesonotum, the four scutellar bristles, and the hind cross vein of the wings being not bordered with fuscous. In the last character they agree with the variety *C. c. nubilus* Hendel, from Formosa; but as I have said in another place,[13] I have never seen specimens with broadly infuscated hind cross vein, in opposition to what is stated by de Meijere.[14] The Philippine specimens with infuscated cross vein belong to the next, very distinct species, *C. mundus*.

LUZON, Laguna Province, Los Baños, Mount Maquiling, and Mount Banahao (*Baker*): Nueva Vizcaya Province, Imugan (*Baker*).

15. Chaetodacus mundus sp. nov. Plate I, fig. 9.

Near the preceding species and closely allied to the Formosan *C. synnephes* Hendel, but distinguished by the unspotted face and the longer ovipositor of the female.

LUZON, Laguna Province, Los Baños (*Baker*), Paete (*McGregor*). PANAY, Antique Province, Batbatan Island (*McGregor*). MINDANAO, Davao (*Baker*). Type in Professor Baker's collection.

Male and female.—Length of body, 6 to 6.5 millimeters; of ovipositor, 1.8 to 2; of wing, 6 to 6.5. Occiput rather convex and shining, yellowish, with a broad reddish brown or blackish patch on each side in the middle; sometimes blackish, with a broad yellow border. Frons of usual shape, less than twice as long as broad; dull yellowish, shining on sides and at vertex; ocellar dot black, lateral and central darkish spots less developed or even wanting. Lunula reddish brown. Antennæ as long as face, first joint short and third narrow and linear, very shortly pubescent; yellowish, with third joint broadly infuscated above and at end. Face shining yellowish and quite unspotted; cheeks linear; jowls as broad as third antennal joint; subocular spot small, brown. Palpi broad, yellowish; proboscis dirty brown. All the bristles black; usually two terminal pairs of lower orbital bristles, very close together and the anterior one much smaller and sometimes wanting.

Back of mesonotum black, punctulate, with pale yellowish pubescence; in the middle two less-distinct longitudinal stripes of grayish dust; beyond the suture three broad yellow longitudinal

[13] Bull. Ent. Research 7 (1916) 110.
[14] Tijdschr. voor Ent. 57 (1914) 191.

stripes, the middle one even broader than supra-alar ones, and all abbreviated before scutellum; humeral and notopleural calli yellow; yellow supra-alar stripes continued with a small yellow spot in front of suture. Pleura black, with reddish sutures and reddish propleural region; on mesopleuron a broad yellow patch continued below with a rather large spot on upper part of sternopleuron; a double yellow hypopleural spot. Mesophragma and postscutellum entirely black. Scutellum yellow, punctulate and whitish dusted, with a very narrow, black basal stripe; two pairs of bristles, the basal pair a little weaker than the apical. All the bristles black; middle scapular long and strong; one anterior supra-alar; pteropleural weaker than mesopleural. Halteres and squamulæ whitish.

Abdomen rounded and convex, restricted at base, with normal segmentation, punctulate and pubescent like back of mesonotum. First and second segments together more yellowish, chiefly on posterior half of second; black at base and on sides, the black base of second forming a black transverse middle band, not reaching sides; long whitish hairs near the base. Third segment reddish; a broad and complete black basal band, broadened on sides; fourth and fifth segments reddish, with a broad black patch on each side; last three segments with a black longitudinal middle stripe, united at base with the black band of third segment, and at end abbreviated a little before reaching hind border of fifth segment. Third segment of male with long black cilia; oval patches of fifth segment in both sexes more opaque and more dusted than the surrounding parts; ovipositor as long as last two abdominal segments together, rather swollen, reddish, more or less infuscated above at base and at end. Venter reddish, with black basal and terminal sternites. Coxæ more or less brownish; femora yellowish, broadly infuscated at end, those of front pair almost entirely infuscated; four anterior tibiæ blackish, two posterior ones even quite black in the female; in the male all tibiæ more lightly colored with darkened end; tarsi whitish at base.

Wings (Plate I, fig. 9) proportionally broad and long, shining and iridescent; nervation normal, with second vein straight, third a little curved downward at end; small cross vein placed a little beyond middle of discoidal cell; last portion of fourth vein curved at base. Supernumerary lobe of male very prominent and exaggerated. Pattern very much like that of *C. synnephes;* costal cells hyaline; costal border narrow, not extending below beyond second vein or only a little so, and not dilated at

end, ending near the middle of exterior border of first posterior cell. First basal cell infuscated above the second; hind cross vein margined with fuscous, fuscous border narrow above, broadened below, and dilated along hind border of wing into third posterior cell, to reach sometimes (chiefly in the male) the anal stripe. The last is very broad and long, being dilated at end in the male and reaching hind border of wing.

16. **Chaetodacus tetrachaetus** sp. nov. Plate I, fig. 10.

Related to the preceding species and likewise distinguished from *C. caudatus* by the smaller size, the black mesonotum, and the distal end of the costal border of the wings not being broadened; but it is distinguished from *C. mundus* and from *C. synnephes* by the brown anal stripe of the wings being quite wanting.

PANAY, Antique Province, Batbatan Island (*McGregor*). Type in my collection.

Male.—Length of body, 6.5 to 7 millimeters; of wing, 6.5 to 7. Head and its appendages as in *C. mundus;* frons without lateral brown spots, but with a distinct and convex middle dark spot, the latter clothed with dense and rather long pubescence; two shining black oval spots on face near end of antennal grooves. Cephalic bristles black; only two pairs of lower orbitals.

Back of mesonotum as in *C. mundus,* but yellow supra-alar stripe prolonged in front of suture to reach humeral calli, as in *C. continuus;* it is moreover reddish in front between humeral callosities, and on sides at outer border of the yellow supra-alar stripe, pleura, mesophragma, and scutellum as in *C. mundus,* but propleural region, lower border of sternopleuron, and breast more broadly reddish; scutellum pellucid on its central part, the yellow sides thus forming a pair of yellow spots. Bristles, squamulæ, and halteres as in *C. mundus.*

Abdomen as in *C. mundus,* but black basal band of second segment extending to sides, being there united with the black lateral border; middle black longitudinal stripe broader and extending to hind border of last segment; lateral black spots of fourth and fifth segments narrower and forming an equal black border; black cilia of third segment more numerous. Femora entirely yellowish and quite unspotted; front and middle tibiæ more or less infuscated; hind tibiæ black and strongly tuberculate before the end; pretarsi whitish.

Wings (Plate I, fig. 10) as in *C. mundus,* but with the super-

numerary lobe less developed; costal brown border narrow and short, not at all dilated at end, and ending only a little beyond end of third longitudinal vein; first basal cell infuscated above second; hind cross vein not infuscated; no brown anal stripe, the anal cell and its prolongation being quite hyaline; only a broad grayish spot around the end of the point of anal cell into third posterior and axillary cells.

Note.—From *C. continuus* the present species is distinguished by the four scutellar bristles, and by the much narrower and much shorter end of the costal brown border of the wings; in *C. continuus* the back of mesonotum is, moreover, reddish in the middle even beyond the suture to the scutellum, while the breast is blacker.

17. **Chaetodacus scutellinus** Bezzi.

Chaetodacus scutellinus BEZZI, Bull. Ent. Research 7 (1916) 113, pl. 2, fig. 11.

A small species, evidently allied to the preceding two, but at once distinguished by the black apical spot on the scutellum.

LUZON, Laguna Province, Mount Maquiling (*Baker*). PALAWAN, Puerto Princesa (*Baker*). Types in Professor Baker's collection.

In the above-cited paper I gave only a summary indication of the present species, of which a complete description follows:

Male and female.—Length of body, 5 to 5.5 millimeters; of ovipositor, 1; of wing, 5 to 5.5. Occiput dark reddish brown in the middle, with a broad and complete yellow border. Frons narrow, about twice as long as broad, opaque, yellowish, a little shining on sides and at vertex, with a small black ocellar dot, a narrow fuscous crossband at vertex, some small, less-distinct, darkish dots at sides, and a small, dark, subquadrate spot in the middle; lunula reddish brown, and above it a darkish crossband in the male. Antennæ yellowish, as long as face, with short first joint; third joint narrow, a little infuscated above and at end. Face concave, shining yellowish, with a small black spot at end of each antennal groove, and moreover with a less-marked dark spot in the middle, above mouth border. Cheeks linear; jowls a little narrower than third antennal joint, with a dark subocular spot. Palpi yellowish; proboscis blackish. Cephalic bristles black; only two pairs of lower orbitals.

Back of mesonotum black, being narrowly reddish only above wings at outer side of yellow supra-alar stripe; punctulate and rather opaque, with a short pale yellowish pubescence; the two broad, grayish, longitudinal stripes distinct in front of suture

alone. Yellow markings as follows: Humeri entirely; notopleural calli; three equally broad longitudinal stripes beyond suture, all abbreviated behind; two supra-alar stripes, one on each side, not at all prolonged in front of suture. Pleura black and rather shining, narrowly reddish in front; a moderately broad yellow stripe on mesopleuron, continued below with a small yellow spot on upper part of sternopleuron; two broad, contiguous, yellow hypopleural spots. Mesophragma entirely black. Scutellum yellow, with a very narrow, black, basal stripe; four bristles, between the apical pair a well-defined subquadrate black spot. Thoracic bristles quite black; middle scapular and pteropleural weak; one anterior supra-alar; prescutellar rather strong. Squamulæ and halteres whitish.

Abdomen oval, not much convex, less restricted at base, with distinct segmentation, punctulate and pubescent like back of mesonotum; first and second segments more yellowish, with black base and black borders, the black basal border of second extending to sides; third, fourth, and fifth segments of a more reddish color, third with a broad and complete black basal band, which is not broadened on sides; middle longitudinal black stripe of last three segments narrow but complete and equal, extending to hind border of fifth segment; last two segments with broad black spots on sides; fifth segment with less distinct oval patches; sixth segment more distinct than usual, being visible from above, and yellowish with a black middle stripe. Venter yellowish, with black sternites, chiefly the last ones in the male; third abdominal segment of male with black cilia; male genitalia reddish brown; ovipositor reddish, rather swollen at base, as long as last three abdominal segments together. Legs with dark brown coxæ; femora yellowish, with a blackish patch before the end; tibiæ yellowish or reddish, but those of the hind pair of legs blackish and in the male distinctly tuberculate before the end; tarsi reddish with whitish base.

Wings (Plate II, fig. 1) proportionally narrow and long, with distinct but not much developed supernumerary lobe in male; last portions of third and fourth veins straight and parallel; small cross vein placed a little beyond middle of discoidal cell. Costal border narrow, not surpassing second longitudinal vein toward the middle, only a little broader at end, but not dilated, and ending obliquely near the middle of exterior border of first posterior cell; costal cells hyaline; stigma blackish; first basal cell infuscated above the second; hind cross vein not infuscated. Anal stripe rather broad and dark, but not dilated at end; shorter and paler in the female.

18. **Chaetodacus pubescens** sp. nov. Plate II, fig. 2.

Chaetodacus scutellatus BEZZI (not of Hendel), Bull. Ent. Research 7 (1916) 114.

Much larger and more pubescent than the preceding species, and moreover distinct on account of the different pattern of thorax, legs, and wings; it is closely allied to true *C. scutellatus* Hendel, from Formosa, differing only in the broader frons and in minor details of thoracic and abdominal markings.

LUZON, Laguna Province, Los Baños and Mount Maquiling (*Baker*). Type in Professor Baker's collection.

Male.—Length of body, 8.5 millimeters; of wing, 8. It seems to differ from Hendel's description of *C. scutellatus* in the following points: Frons broader, being not twice as long as broad. On back of mesonotum the yellow humeral calli surrounded with reddish, not with black; middle yellow longitudinal stripe broader than lateral ones. Abdomen with black basal bands only on second and third segments; fourth and fifth segments with only a broad black spot on each side. Opaque oval patches of fifth segment distinct; fifth segment, moreover, longer than usual, being only a little shorter than the two preceding segments together. Legs entirely reddish yellow and quite unspotted, only the hind tibiæ being brownish. Apical fuscous spot of costal border broader, extending below to middle of first posterior cell (Plate II, fig. 2); no distinct infuscation at lower end of hind cross vein or only a very much less-developed one. Pubescence of body longer than in any of the allied forms.

Note.—In consequence of my mistake in regard to the Philippine species here described as *C. pubescens*, the Japanese (and Chinese) species, to which Miyake [15] has recently given the name of *Dacus bezzii*, is probably the same as the Formosan *C. scutellatus* Hendel; at least I cannot distinguish them from descriptions and figures.

III. Genus MELLESIS Bezzi, 1916

All the species here comprised in the present genus are typical in having a well-developed basal stalk of the abdomen (except *M. subsessilis*), an elongated first antennal joint, a mesonotum with interrupted suture and with no prescutellar bristles, and a scutellum with only the apical pair of bristles. They all have nonspinose femora, distinct lower orbital bristles (except *M. bioculata*), and well-developed anterior supra-alar bristles. To

[15] Bull. Imp. Central Agr. Exp. Sta. Japan 2 (1919) 146, pl. 2, fig. 2.

the characters of the genus may be added: Face very short in the middle, much shorter than the antennal grooves, which are sometimes twice as long as it. Lunula broad. Scutellum short and transverse. Wings short, distinctly shorter than body. The swollen ovipositor, on account of the abdominal club being very convex above and very concave beneath, is placed very deeply below the rounded hind border of the last abdominal segment.

Chaetodacus bakeri, of which I am not sure about the presence of the prescutellar bristles, and which, for *Chaetodacus,* has an unusually broad frons, is perhaps a member of the present genus; but in this case it may be distinguished from all the others by its first antennal joint being not elongated. The face, however, is long and shaped as in *Chaetodacus.*

The species of *Mellesis* seem to be rarer in the Islands than those of the preceding genus; at least I have received only few and scattered specimens of them. They can be distinguished with the aid of the following table; two of them (*M. pedunculata* and *M. nummularia*) are already named, but not described by me in another paper. [16]

a^1. Abdominal stalk less developed, short, broad, and depressed; fourth and fifth abdominal segments entirely reddish at sides. **M. subsessilis sp. nov.**

a^2. Abdominal stalk very distinct, long, thin, and cylindrical; last abdominal segments with black spots at sides.

b^1. Frons very broad, with less-developed lower orbital bristles; a single yellow hypopleural spot; oval patches of fifth abdominal segment black; wings with narrow and elongate second basal cell, with no distinct anal stripe, and with costal border equally broad to the end..... **M. bioculata sp. nov.**

b^2. Frons narrower and with well-developed orbital; hypopleural spot double; oval patches not black; wings with short and broad second basal cell.

c^1. Face with a black transverse band just above mouth border; mesonotum with no yellow postsutural middle stripe; costal border of wings narrow, not extending beyond third vein or only a little so near the end; no brown anal stripe on wings. **M. pedunculata Bezzi.**

c^2. Face with two black spots; mesonotum with yellow middle stripe; costal border dilated at end into a very broad rounded spot, which is extended below into second posterior cell; anal stripe well developed..... **M. nummularia Bezzi.**

19. **Mellesis subsessilis** sp. nov. Plate II, fig. 3.

A robust species of proportionally greater size, very distinct

[16] Bull. Ent. Research 7 (1916) 115.

on account of its less-stalked abdomen, which, moreover, lacks the lateral black spots.

PANAY, Antique Province, Culasi (*McGregor*), June, 1918. Type, a single female specimen, in my collection.

Female.—Length of body, more than 9 millimeters; of ovipositor, 1.5; of wing, 8. Occiput of a shining, pale reddish color, with a broad, pale-yellowish border. Frons parallel-sided, one and one-half times as long as broad, opaque, with shining vertical plates; dirty reddish with yellow sides, a broad, rounded, darkish spot, clothed with erect pubescence on its front half; dark orbital spots indistinct; lunula very broad, shining reddish yellow. Face short and broad, flat in the middle but prominent at mouth border, shining yellow, with a broad black spot on inner apical side of each antennal groove; cheeks rather broad; jowls broader than breadth of third antennal joint. Antennæ with third joint wanting in the type, but to judge from the two basal joints they must be very long, much longer than face; first joint as long as elongate second joint, both yellowish in color. Palpi yellowish; proboscis dirty reddish. Cephalic bristles black, even the rather strong genal one; two pairs of well-developed lower orbitals; postvertical short and yellowish, hairlike.

Thorax broad and robust, rather convex above; on back of mesonotum punctate and clothed with proportionally long, pale-yellowish pubescence; opaque black on middle, reddish in front, on sides, and before scutellum. Yellow markings as follows: Entire humeral calli; notopleural calli; and a broad transverse stripe in front of the suture, as broadly interrupted in the middle as thoracic suture. Pleura punctate and less shining, with whitish pubescence; reddish, broadly black in the middle, with the following yellow markings: A mesopleural stripe, continued with a not much larger yellow spot on upper border of sternopleuron; a double hypopleural spot. Mesophragma entirely black like postscutellum, gray dusted, hardly reddish brown in the middle. Scutellum proportionally small, punctate and pubescent like back of mesonotum, yellow, with a narrow brownish basal stripe; bearing only the apical pair of bristles, the latter black. Thoracic bristles black, scapular bristles very strong and long, even those of middle pair; one anterior supra-alar; no prescutellar; pteropleural weaker than mesopleural. Squamulæ and halteres whitish.

Abdomen rather elongate and convex; not properly stalked at base, first segment being not much restricted and not cylindrical;

prominent basal tubercles of first segment very well developed; punctulate and pubescent like back of mesonotum, but the first two segments clothed on sides with long, erect, whitish hairs. First segment entirely reddish, with less-distinct, darkish, longitudinal middle stripe; second segment reddish at base, yellowish on more than its apical half, with less-distinct middle stripe, and with no black spots at sides; third, fourth, and fifth segments entirely reddish, with no black spots on sides, with only a narrow and complete, black longitudinal stripe in the middle; venter very concave; reddish, with brown apical sternites. Segmentation distinct; sixth segment not visible. Ovipositor reddish, very much swollen at base. Legs entirely reddish, with pale pubescence; tibiæ paler, base of tarsi whitish; middle tibiæ with a strong black spur.

Wings (Plate II, fig. 3) shorter than body, shining and iridescent; veins reddish; second longitudinal vein straight; last portions of third and the fourth parallel, the latter less curved at base; small cross vein placed beyond middle of discoidal cell. The pattern consists of a yellowish and broad, complete costal border, comprising even costal cells and extending below to third vein; in first posterior cell this border extends below third vein to reach middle of cell and is more intensively dark; this darker, but less-sharply defined, apical spot continued below with a darkish shade, passing over fourth vein into upper part of second posterior cell. Stigma not darker; first basal cell darkened above second. Yellowish anal stripe broad, but not extending to hind border of wing. Second basal cell rather broad.

20. Mellesis bioculata sp. nov. Plate II, fig. 4.

Very distinct from all the other species on account of the single hypopleural spot and the peculiar wing pattern.

LUZON, Laguna Province, Mount Maquiling (*Baker*). Type in Professor Baker's collection.

Male.—Length of body, 10 millimeters; of wing, 8.5. Head as in the preceding species, but frons distinctly shorter and broader, being about as long as broad; of the antennæ there is only the first joint, which is elongate and yellowish; black facial spots much smaller and rounded; cephalic bristles black, but it seems that the lower orbitals are very much less developed, only the first pair being distinguishable.

Mesonotum distinctly narrower; entirely reddish on the back, with three very narrow, blackish longitudinal stripes and two

blackish spots in front of scutellum; humeri yellow, but with interior hind border reddish; yellow sutural stripe narrower. Pleura entirely reddish, only a little darkened around the yellow markings; yellow mesopleural stripe narrower; only the hypopleural yellow spot present, that on sides of mesophragma being indistinct or only indicated by a more-yellowish inner border in contact with the above-named spot; mesophragma entirely reddish and unspotted. Bristles as in the preceding, with anterior supra-alar bristle well developed. Scutellum small and short, much broader than long, yellow with a narrow brownish basal stripe. Halteres and squamulæ whitish.

Abdomen with long, narrow, and cylindrical stalk; first and second segments dark brownish, with a narrow yellow hind border; third segment uniformly blackish brown; fourth segment blackish brown, with a rectangular, transverse, yellowish spot in middle at hind border; fifth segment yellowish, with broad blackish patches on sides, and with the two oval patches likewise black, hind border of segment entirely pale yellowish. Venter with blackish terminal sternites. Long, whitish, erect pubescence near base of abdomen. Legs reddish, femora broadly blackish; base of tarsi not whitish; middle femora with a pale yellowish base.

Wings (Plate II, fig. 4) as in the preceding, but with second basal cell much longer and narrower. The pattern consists of an equal, dark, costal border, extending from base to tip of wing, surpassing a little the third longitudinal vein below; no spotlike dilatation at end; anal stripe not distinct or else indicated only by a yellowish shading. Prolongation of anal cell very long, extending about to hind border of wing. No supernumerary lobe at end of sixth vein.

Note.—The present species belongs in the group with the Indian *M. crabroniformis* Bezzi, and the Burman *M. destillatoria* Bezzi; it has likewise no developed lower orbital bristles, a single yellow hypopleural spot, a narrow and elongate second basal cell, a similar wing pattern with a broad and equal costal border, and with no developed anal stripe. It is, however, distinguished from both by the black oval patches of the fifth abdominal segment and by the differently colored legs. The species *M. aequalis* Coquillett, *M. longicornis* Wiedemann (= *vespoides* Doleschall), and *M. conopoides* de Meijere, evidently belong to the same group, but the last two are said to have spinose front femora.

21. Mellesis pedunculata Bezzi. Plate II, fig. 5.

Mellesis pedunculata BEZZI, Bull. Ent. Research 7 (1916) 115.

A small species with a well-stalked abdomen, very distinct on account of its banded face and its simple wing pattern.

LUZON, Laguna Province, Mount Maquiling (*Baker*). Mindanao, Davao (*Baker*). Type in Professor Baker's collection.

Male.—Length of body, 7.5 millimeters; of wing, 6; of the whole antenna, about 2. Occiput black in the middle, with a reddish spot above from neck to vertex, and with a yellow border, the latter a little broadened below. Frons proportionately narrow, less than twice as long as broad; reddish at base with yellow vertical plates, with yellow borders, and moreover rather yellowish in front; at vertex a black crossband including the black ocellar dot; a dark spot toward the middle shaped as a broad transverse band. Lunula broad, shining brownish. Face very short in the middle, with less prominent mouth border; shining yellowish, with a shining black transverse band just above mouth border, rather dilated toward middle of antennal grooves; a small black spot just below root of antennæ. Cheeks not properly linear; jowls broader than third antennal joint, with a brown subocular spot. Antennæ very long, much longer than face; first joint very elongate, entirely reddish, nearly bare; second joint a little shorter than first, blackish at base, reddish at end, with dark hairs; third joint narrow and elongate, quite blackish; arista yellowish, about as long as the whole antenna. Palpi and proboscis dirty yellowish. Cephalic bristles black; two pairs of well-developed lower orbitals; genal bristle well developed; postverticals not distinct or hairlike.

Mesonotum broad and less convex, with interrupted suture; punctate, opaque, clothed with a short yellowish pubescence; back reddish, with two black, longitudinal, middle stripes, prolonged beyond suture but not reaching scutellum, and with two broad black patches, one on each side, including the interrupted, yellow, transverse sutural stripe; humeral callosities entirely yellow. Pleura black in the middle, reddish on sides and below, punctate like the back but a little more shining; yellow mesopleural stripe moderately broad, continued below with a yellow spot on upper border of sternopleuron; hypopleural spot double. Mesophragma black, with a reddish vertical stripe along the middle. Scutellum twice as broad as long, yellow, with a nar-

row reddish-brown basal stripe; with two black bristles at end. Thoracic bristles black; middle scapular as strong as lateral ones; one anterior supra-alar; pteropleural a little weaker than sternopleural. Squamulæ dirty whitish; halteres whitish.

Abdomen with a thin, cylindrical basal stalk and with an oval terminal club; punctate and pubescent like back of mesonotum, but long and erect whitish hairs at base on sides; segmentation distinct; third segment with long black cilia. First and second segments black with yellowish hind border, that of second being broader and not extending to sides; third segment entirely black; fourth and fifth segments long, the latter longer than the former, black, with a broad reddish yellow middle patch, which has on the middle a narrow, black longitudinal stripe, ending before hind border of last segment. Oval patches of fifth segment less distinct, shining but not differently colored. Venter very concave, with yellowish membrane and with black sternites, basal one clothed with long whitish hairs; genitalia reddish. Coxæ reddish brown; femora black in the middle, yellowish at base, reddish at end; tibiæ reddish, more or less darkened, the posterior ones being more broadly blackish; tarsi reddish, with pale base; spur of middle tibiæ long and black.

Wings (Plate II, fig. 5) proportionally short, shining and iridescent. Veins black, second straight, third less curved downward at end and parallel with the last portion of fourth, which is less curved at base; small cross vein a little beyond middle of discoidal cell; second basal cell broad, but about twice as long as broad; prolongation of anal cell very long; no supernumerary lobe. Pattern very simple and less developed, consisting only of a narrow, dark, costal border, in the middle not extending beyond second longitudinal vein, while at end it is a little dilated below third vein but without being spotlike. First basal cell infuscated above second; hind cross vein not infuscated; anal stripe quite wanting, only a grayish shade being present at end of the point of anal cell, into the terminal outer angle of the axillary cell. Costal cells a little infuscated; stigma darker.

Note.—The description of the Javanese *M. conopoides* de Meijere is very much like that of the present species, which, however, is different in having well-developed lower orbital bristles and in having nonspinose front femora.

22. **Mellesis nummularia** Bezzi. Plate II, fig. 6.

Mellesis nummularia Bezzi, Bull. Ent. Research 7 (1916) 115.

Allied to the preceding species, but distinct by the paler coloration of the body and of the legs, as well as by the richer wing pattern, which has a broad, rounded, apical, dark brown patch.

Luzon, Laguna Province, Los Baños, Mount Maquiling and Mount Banahao (*Baker*). Types in Professor Baker's collection.

Male and female.—Length of body, 8 to 8.5 millimeters; of wing, 7 to 7.5; of antenna, more than 2; of ovipositor, 1.5. Head and its appendages as in the preceding species; but occiput reddish, with a narrow yellow border, frons less distinctly yellow on sides, with a black ocellar dot, a reddish brown vertical stripe, and the middle transverse spot less developed; face without black spot just below root of antennæ, and with two broad rounded black spots, one on each side toward middle of antennal grooves; antennæ paler, third joint being only in part infuscated; two pairs of lower orbital bristles thinner, but always well developed.

Mesonotum as in the preceding and with the same yellow markings; but prevalently reddish on back, the black pattern being reduced to a narrow, middle, longitudinal stripe, ending at suture, and to two small patches, one on each side, near the yellow sutural stripe; characteristic for the present species is a short yellow middle stripe, which begins acutely just beyond suture and ends obtusely midway between suture and scutellum. Pleura entirely reddish, with only a small black patch on mesopleuron in front of yellow mesopleural stripe. Mesophragma reddish, with blackish sides; postscutellum reddish; scutellum as in the preceding species. Chætotaxy the same and bristles likewise black.

Abdomen as in the preceding, but with basal stalk a little broader; second segment more broadly yellowish at hind border, and in the middle a short, dark, longitudinal stripe not reaching hind border; third segment yellowish in the middle behind, the yellow being thus united with the yellowish patches of the last two segments, and the middle longitudinal black stripe beginning with it. Cilia of third segment longer; ovipositor conical, dark reddish. Four anterior femora more or less blackened, the posterior ones being quite yellowish and unspotted.

Wings (Plate II, fig. 6) in shape and venation as in the preceding species, but with reddish veins. Costal border less darkened, more yellowish, and extended in the middle to third longitudinal vein; at apex of wing a broad, rounded, dark spot, which extends below beyond fourth vein, entering with its lower border into second posterior cell; end of first posterior cell narrowly subhyaline, the apical spot being thus rather separated from wing border; inwardly the apical spot extends to a little before upper end of hind cross vein. Anal stripe well developed, but not reaching hind border of wing and not dilated at end. First basal cell infuscated above second; hind cross vein not bordered with fuscous.

IV. Genus MONACROSTICHUS Bezzi, 1913

The long, convex, and bituberculate face, the lack of lower orbital bristles, the continuous transverse suture of mesonotum, the unpaired acrostichal bristle, the spinose front femora, the narrow second basal cell, and the restricted base of the discoidal cell are the main features of this very distinct genus. To these may be added that the first posterior cell is narrowed at end, and that the sixth longitudinal vein is not extended to the hind border of the wing. The anterior supra-alar bristle is present, while the middle scapular bristles are wanting.

23. Monacrostichus citricola Bezzi. Plate II, fig. 7.

Monacrostichus citricola BEZZI, Philip. Journ. Sci. § D 8 (1913) 323.

Distinguished from all the preceding species of the genus *Mellesis* by the peculiarly patterned face with entirely black antennal grooves; by the yellow supra-alar stripes on the sides of mesonotum, even a short posthumeral stripe being present; by the complete black crossbands at base of fourth and fifth abdominal segments; by the nonciliated third abdominal segment of the male; by the flattened ovipositor of the female; and by the very simple wing pattern (Plate II, fig. 7). The dark transverse band of the face in the present species is not placed just above the mouth border as in *M. conopoides* or in *M. pedunculata;* but it is narrow and placed toward the middle, just below the upper facial tubercle; it is saddle-shaped, and from its lower angle branches a short, vertical, dark stripe, which runs to the upper mouth border.

LUZON, Laguna Province, Los Baños (*Baker*), reared from *Citrus* fruits. I have seen only the typical specimens.

ILLUSTRATIONS

[Drawings by M. Bezzi.]

PLATE I

FIG. 1. *Chaetodacus atrichus* sp. nov., wing of female.
2. *Chaetodacus ablepharus* sp. nov., wing of male.
3. *Chaetodacus ferrugineus occipitalis* var. nov., wing of male.
4. *Chaetodacus ferrugineus pedestris* Bezzi, wing of male.
5. *Chaetodacus ferrugineus limbiferus* var. nov., wing of male.
6. *Chaetodacus continuus* sp. nov., wing of female.
7. *Chaetodacus mcgregori* sp. nov., wing of male.
8. *Chaetodacus bakeri* sp. nov., wing of male.
9. *Chaetodacus mundus* sp. nov., wing of male.
10. *Chaetodacus tetrachaetus* sp. nov., wing of male.

PLATE II

FIG. 1. *Chaetodacus scutellinus* Bezzi, wing of male.
2. *Chaetodacus pubescens* sp. nov., wing of male.
3. *Mellesis subsessilis* sp. nov., wing of female.
4. *Mellesis bioculata* sp. nov., wing of male.
5. *Mellesis pedunculata* Bezzi, wing of male.
6. *Mellesis nummularia* Bezzi, wing of male.
7. *Monacrostichus citricola* Bezzi, wing of male.

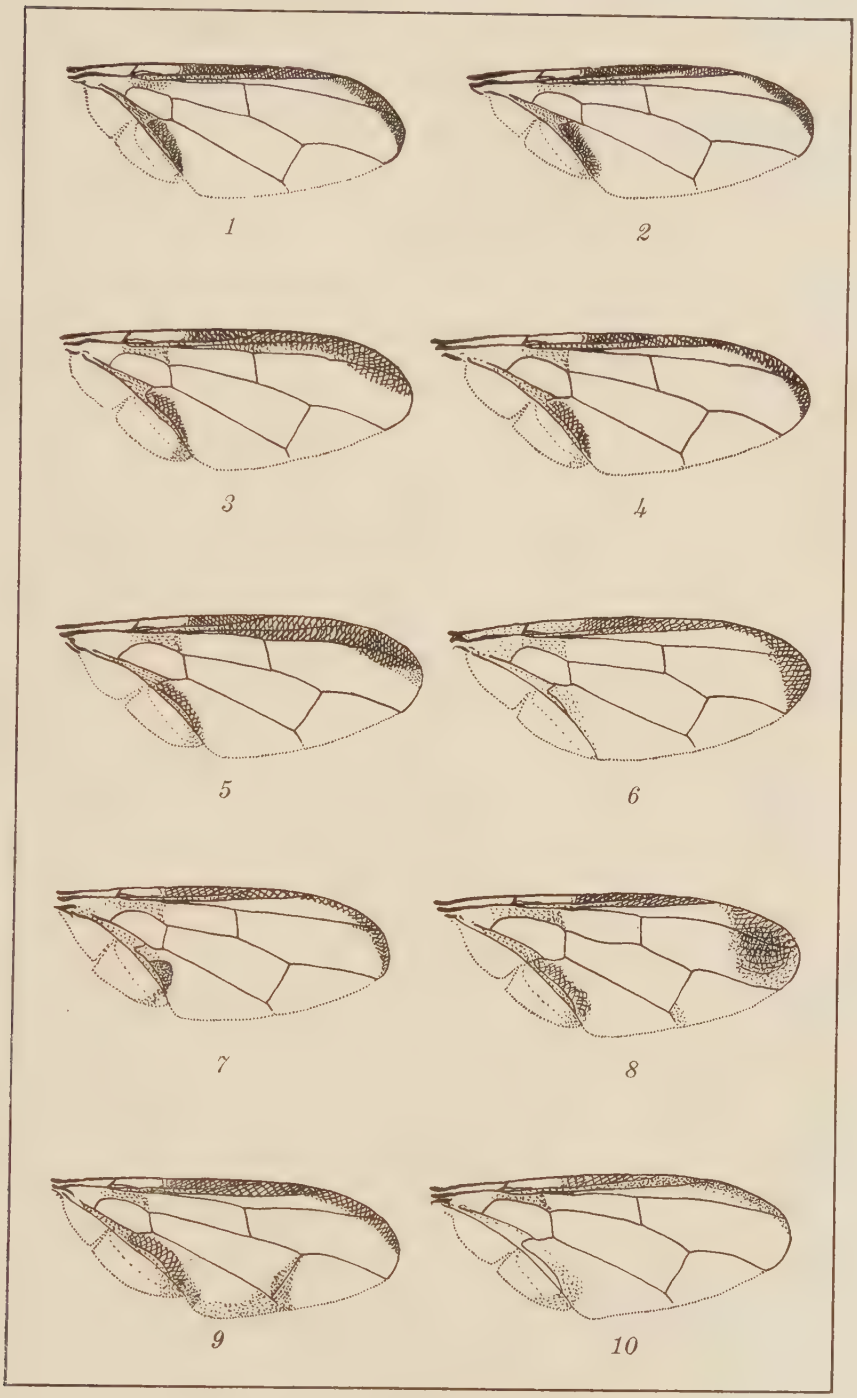

PLATE 1. PHILIPPINE FRUIT FLIES.

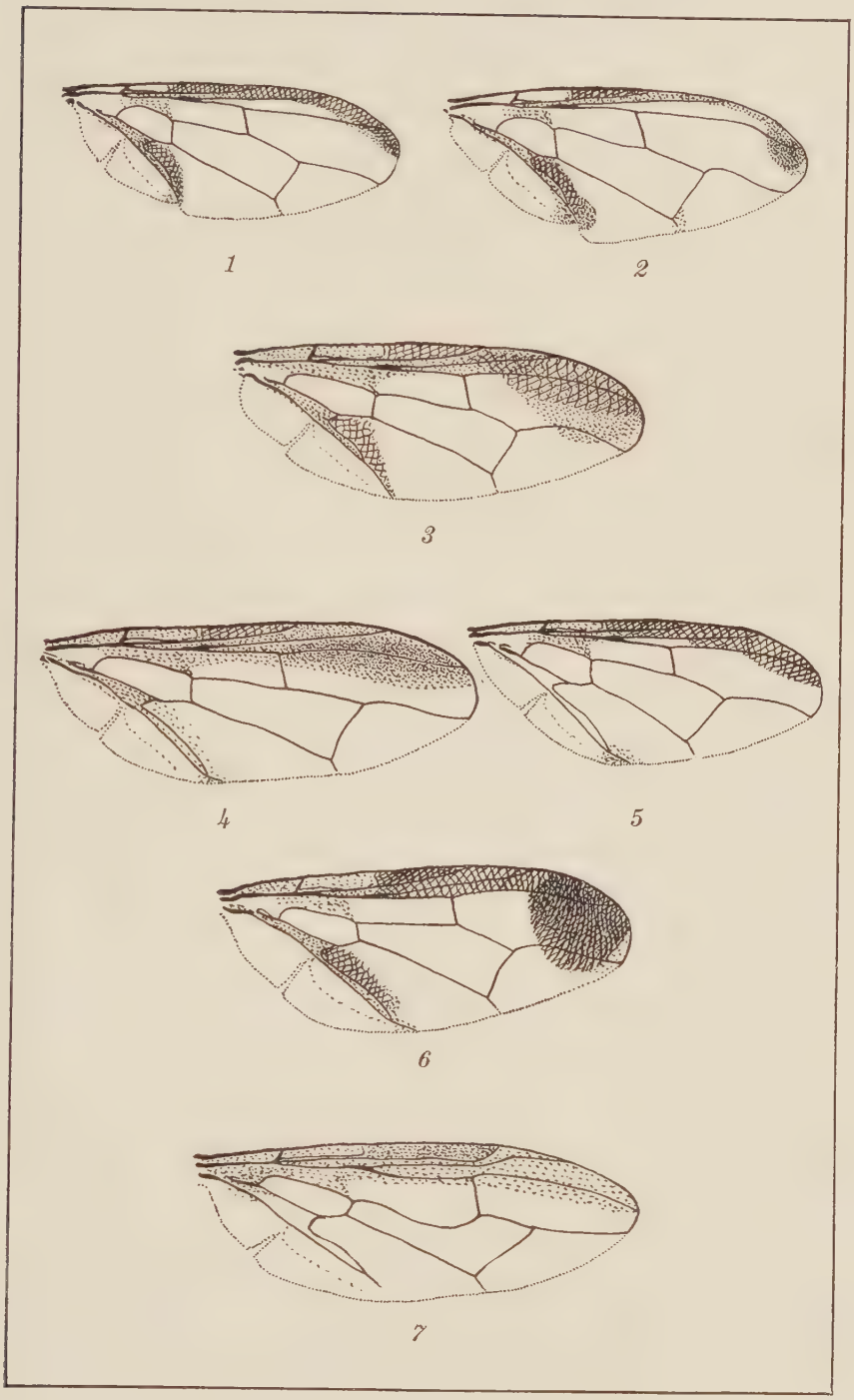

PLATE II. PHILIPPINE FRUIT FLIES.

MELASIDÆ NOUVEAUX (COLÉOPTÈRES) RÉCOLTÈS PAR C. F. BAKER

Par Ed. Fleutiaux

Nogent-sur-Marne, France

Depuis la publication d'un premier mémoire sur les Melasidæ recueillis aux Iles Philippines par M. Baker,[1] j'ai recu de lui plusieurs autres envois contenant des espèces de la région indo-malaise dont un certain nombre sont nouvelles. Il donne ci-après les descriptions de quelques unes d'entre elles.

Subprotelater guttatus sp. nov.

Allongé, parallèle, peu convexe, noir mat, pubescence jaune à peine apparente, élytres ornés chacun de quatre taches blanchâtres. Tête convexe á ponctuation large et ombiliquée; épistome brunâtre, largement impressionné. Antennes noires, n'atteignant pas la base du prothorax, ferrugineuses á la base. Pronotum plus long que large, à peine rétréci en avant, brusquement déprimé à la base; ponctuation large et ombiliquée; angles postérieurs aigus et carénés. Ecusson perpendiculaire. Élytres parallèles, arrondis au sommet, rugueux, fortement ponctués-striés, ornés de quatre tâches blanchâtres à peu près semblables: une à la base en dedans de l'angle huméral; une autre au premier tiers, sur les 3e et 4e interstriés; une troisiéme un peu plus grande, arrondú avant l'extrémité près du bord latéral; la quatrième au quart antérieur du bord latéral sur les trois dernièrs interstriés. Dessous le même couleur. Propectus à ponctuation grosse assez serrée. Métasternum à ponctuation moins forte. Episternes parallèles de la même largeur que les épipleures. Hanches postérieures non rétrécies en dehors; bord externe beaucoup plus large que les episternes; bord inférieur sinué. Ponctuation de l'abdomen semblable à celle du métasternum. Pattes ferrugineuses, fémurs plus au moins noirâtres.

Longueur, 3.5 millimètres.

Singapore.

Plus court que *P. bakeri* Fleutiaux. Élytres sans bandes ranges obliques en arrière de l'écusson, ni tache linéaire sub-

[1] Philip. Journ. Sci. § D 11 (1916) 387.

suturale près du bout; la tache ronde subapicale plus en arrière.

Dromaeolus cylindricus sp. nov.

Allongé, cylindrique, noir, brillant sur la partie postérieure des élytres, pubescence jaune sur la moitié antérieure, obscure sur la moitié postérieure. Tête convexe, assez fortement et densément ponctuée; épistome rétréci à la base où il est deux fois plus étroit que l'espace compris entre le fond de son échancrure et l'oeil. Antennes noirâtres, subcomprimiés, dépassant à peine la base du pronotum; 4e et 5e articles égaux, un peu plus longs que larges. Pronotum plus long que large, parallèle, arrondi en avant, convexe, aplati et sillonné au milieu en arrière, assez fortement rugueux. Élytres parallèles en avant, graduellement rétrécis en arrière, aplatis et biimpressionnés à la base, convexes à l'extrémité, rugueux sur la tiers antérieur, très finement ponctué au delà, très légèrement striés. Dessous de même couleur, pubescence semblable sur toute la surface; ponctuation assez forte. Episternes suparallèles, un peu plus étroits que les épipleures. Hanches postérieures dilatées en dedans, plus larges en dehors que les épisternes. Dernier segment abdominal en pointe obtuse. Pattes noirâtres, tarses brunâtres; tibias et tarses antérieurs ferrugineux.

Longueur, 6 millimètres.

BORNÉO, Sandakan.

Moins allongé que *D. semigriseus* Bonvouloir. Partie antérieure du corps moins densément rugueuse; front sans caréne; pronotum moins long, moins convexe en arrière; élytres distinctement biimpressionnés à la base.

Dromaeolus bipartitus sp. nov.

Allongé, subcylindrique, noir peu brillant, pubescence grise sur la moitié antérieure, brune sur la moitié postérieure. Tête convexe, finement et densément ponctuée; épistome aussi large à la base que l'espace compris entre le fond de son échancrure basale et l'oeil. Antennes noires. Pronotum un peu plus long que large, parallèle en arrière, arrondi dans la moitié antérieure, convexe, fortement déprimé à la base, sillonné au milieu sur les deux tiers de sa longueur; ponctuation assez forte, serrée et subrugueuse sur la milieu, plus légère en avant qu'en arrière, presque effacée le long de la base. Élytres subparallèles en avant, faiblement et graduellement attenués au delà de la moitié, déhiscents au sommet, terminés en pointe légèrement striés;

ponctuation fine, très espacée surtout en arrière. Dessous noir peu brillant, pubescence grise peu apparente. Episternes parallèles, plus étroits que les épipleures. Hanches postérieures très élargées et anguleuses en dedans, de la même largeur en dehors que les épisternes. Dernier segment abdominal atténué en arrière, arrondi au sommet. Patte noires, tarses antérieurs et derniers articles des autres jaunâtres.

Longueur, 6.5 millimètres.

SINGAPORE.

Voisin de *D. cylindricus* Fleutiaux. Moins convexe et moins cylindrique, moins fortement ponctué. Pronotum rétréci en avant à partir de la moitié. Élytres plus attenués en arrière, déhiscents à l'extrémité, plus brillants, à ponctuation plus légère écartée.

Dromaeolus depressus sp. nov.

Oblong, assez large, déprimé, noir brillant, pubescence formir de poils raides, jaune sur la tête, la pronotum et une partie des élytres, brune à l'extrémité. Tête assez convexe, très finement ponctuée, caréne interoculaire entiére; épistome très rétréci à la base, où il est plus étroit que l'espace compris entre lui et l'oeil. Antennes brun obscur, avec le sommet du premier article, la 2e et les derniers rougeatres; 2e à peu près de la longueur du 4e; 3e aussi long que les deux suivants réunis; 4e et 5e subégaux. Pronotum moins long que large arrondi en avant, peu convexe, faiblement déprimé à la base; ponctuation plus forte que sur la tête, peu serrée. Ecusson arrondi et ponctué. Élytres atténués en arrière, indistinctement striés, ponctuation plus serrée à la base, espacée au delà. Dessous de même couleur, ponctuation au peu plus forte en avant, plus serrée en arrière. Pattes ferrugineuses.

Longueur, 4.5 millimètres.

BORNÉO, Sandakan.

Voisin de *D. opacus* Bonvouloir; d'un forme générale plus courte et déprimée.

Fornax dorsalis sp. nov.

Elliptique, noir brillant, pubescence jaune apparente sur la base du pronotum et des élytres et formant une tache assez grande sur la suture au delà de la moitié. Tête à ponctuation fine, caréne interoculaire entiére; épistome très rétréci à la base. Antennes ferrugineuses; 2e article petit; 3e presque aussi long que les deux suivants réunis; 4e à peine plus long que la 2e.

Pronotum convexe en avant, déprimé en arrière, arrondi sur les côtés et rétréci en avant; ponctuation assez forte, peu serrée. Élytres graduellement rétrécis en arrière, arrondis au sommet, légèrement rugueux tout à fait à la base, finement et éparsément ponctuée, marqués seulement d'un seule strié suturale. Dessous brunâtre, pubescence jaune, ponctuation assez forte sur la propectus et la métasternum, fine sur l'abdomen. Pattes ferrugineuses.

Longueur, 3.5 millimètres.

BORNÉO, Sandakan.

Même forme que *F. scutellaris* Fleutiaux. Aspect plus brillant, pubescence jaune moins étendue sur la pronotum et formant une tache sur la suture des élytres, ponctuation moins marquée sur la pronotum, base des élytres moins rugueuse.

Fornax umbilicatus sp. nov.

Fusiforme, convexe, brun noirâtre peu brillant, pubescence jaune sur la moitié antérieure, brune en arrière. Tête convexe, densément et assez fortement ponctuée, carénée au milieu; épistome rétréci à la base où il est plus étroit que l'espace compris entre le fond de son échancrure et l'oeil. Antennes ferrugineuses, cylindriques, dépassant à peine la base du prothorax; 2e article subégal au 4e; 3e presque aussi long que les deux suivants réunis. Pronotum un peu plus long que large, parallèle en arrière, rétréci en avant au delà de la moitié, convexe, déprimé à la base, marqué sur les côtés d'une faible dépression et d'une ligne lisse sillonnée au milieu en arrière; ponctuation ocellée. Ecusson carré. Élytres graduellement rétrécies rugueuses à la base, éparsément ponctués en arrière, légèrement striés. Dessous de même couleur, pubescence plus fine, moins apparente; ponctuation forte et serrée sur la propectus et la metasternum, moins bien marquée sur l'abdomen. Prosternum sillonné transversalement près du bord antérieure sur une grande partie de sa largueur; saillie large et déprimée. Sillons antennaires nettement limités par leur fond lisse et brillant. Episternes étroits en avant, élargés en arrière. Hanches postérieures, triangulaires, larges, anguleuses, fortement rétrécies en dehors où elles sont un peu plus larges que la bord inférieur des épisternes. Dernier segment abdominal comprimé, râpeux au sommet, tronqué et ouvert, terminé au milieu par une dent. Pattes ferrugineux obscur; fémurs noirâtres; angles petits, minces, non dentés.

Longueur, 6.5 millimètres.

BORNÉO, Sandakan.

Voisin de *F. fusiformis* Fleutiaux; plus grand, plus convexe, ponctuation en pronotum forte et ombiliquée. Egalement voisin de *F. tenuis* et de *F. subacuminatus* Bonvouloir par la forme du dernier segment abdominal.

Fornax melanopterus sp. nov.

Oblong, jaune rougeâtre, élytres noirs, pubescence jaune clair. Tête convexe, impressionnée en avant, ponctuation large et ombiliquée; caréne interoculaire interrompue au milieu; épistome rugueux, rétréci à la base où il est plus étroit que l'espace compris entre le fond de son échancrure et l'oeil. Antennes atteignant la moitié en corps, jaune obscur, premiers articles jaune clair, comprimées et dentées à partir du 3e article; 2e très petit; les suivant subégaux. Pronotum un peu plus long que large, parallèle, arrondi au sommet, convexe, déprimé en arrière, sillonné au milieu de la base; ponctuation ombiliquée. Ecusson presque carré, convexe, ponctué. Élytres sub-parallèles dans la premiere moitié et attenués en rond au delà, ponctués plus densément à la base, substriés. Dessous jaune rougeâtre. Pattes jaune pàle.

Longueur, 5 à 6 millimètres.

BORNÉO, Sandakan.

Jolie petite espéce dont la coloration rappelle *F. venustus* Bonvouloir. Taille beaucoup plus petite, antennes plus longues et dentées, ponctuation de la tête et en pronotum ombiliquée, celle des élytres plus grosse.

Fornax diapodioides sp. nov.

Allongé, convexe, brun, un peu rougeâtre sur les élytres surtout le long de la suture et plus clair au sommet, pubescence jaune, brune sur la disque des élytres en arrière et formant une tache oblongue n'atteignant pas l'extrémité et traversée par la pubesence jaune le long de la suture. Tête très convexe et densément ponctuée; épistome non caréné à la base où il est aussi large que l'espace compris entre le fond de son échancrure et l'oeil. Antennes ferrugineuses, filiformes, dépassant la base en prothorax; 2e article très petit; 3e un peu plus long que la 4e; suivant égaux. Pronotum plus long que large, parallèle en arrière, rétréci et arrondi en avant, convexe, marqué de deux faibles impressions en avant de la moitié, déprimé à la base de chaque côté du lobe médian; celui-ci saillant, tronqué en arrière; ponctuation assez forte, serrée et rugueuse, plus fine sur la partie déchiré de la base. Écusson assez grand, subquadrangulaire,

rugueux. Élytres convexes, légèrement déprimé de chaque côte de l'écusson, parallèles en avant, graduellement attenués à partir de la moitié, échancrés et bidentés au sommet, finement ponctués, légèrement rugueux á la base, substriés. Dessous d'un brun noirâtre, pubescence jaune. Abdomen convexe, dernier segment tronqué latéralement et terminé au milieu par une saillie arrondié. Pattes ferrugineuses; fémurs obscurées surtout les postérieurs; ongles petites et dentés.

Longueur, 6.5 millimètres.

BORNÉO, Sandakan.

Cette curieuse espéce rappelle par son aspect *Diapodius griseus* Bonvouloir. Sa pubescence bicolore affecte à peu près la même disposition.

Dyscolocerus bakeri sp. nov.

Oblong, convexe, ferrugineux plus brillant sur la pronotum, pubescence jaune peu abondante. Tête étroite, convexe, ponctuation assez large, peu profonde, légèrement rugueuse; épistome très étroit à la base où il est beaucoup moins large que l'espace compris entre lui et l'oeil. Antennes robustes, ferrugineuses à la base, obscures au sommet; 1er article épais, aussi long que les trois suivants réunis; 2^{e} à 8^{e} plus étroits, courts, moniliformes, 3^{e} un plus long que les autres; 9^{e} environs aussi long que les 2^{e} a 8^{e} réunis; 10^{e} et 11^{e} de même longueur que la 9^{e}, ces trois derniers plus épais que les précédents. Pronotum plus large que long, rétréci en avant, sinné sur les côtés, convexe, déprimé en arrière, brillant; ponctuation nette, peu serrée sur la disque, faiblement rugueuse latéralement. Élytres subparallèles, rétrécis en arrière à partir de la moitié, arrondis au sommet, convexes, légèrement déprimés à la base, densément ponctués, distinctement striés. Dessous de même couleur, ponctuation grasse et superficielle sur les propleures, plus fine et plus nette sur la prosternum; saillie courte, large. Métasternum à ponctuation fine et peu serrée. Episternes parallèles, plus étroits que les épipleures à la moitié en leur longueur. Hanches postérieures fortement et anguleusement élargies en dedans. Abdomen densément ponctué; dernier arceau largement arrondi. Pattes ferrugineux clair.

Longueur, 5 millimetrès.

BORNÉO, Sandakan.

Voisin de *D. subnitidus* Bonvouloir. Taille moindre, couleur plus claire, aspect plus brillant, dernier article des antennes aussi long que la précédent.

SOME ABNORMALITIES OF THE VERTEBRAL ARTERY [1]

By Miguel Cañizares

Of the Department of Anatomy, University of the Philippines, Manila

ONE PLATE AND FIVE TEXT FIGURES

The considerable number of marked abnormalities of the vertebral artery met with in the department of anatomy in the course of our dissections there within the last two years, and their apparent practical importance and embryological significance, suggested the preparation of this report on the subject.

The observations were made on forty cadavers used in the dissecting rooms of the College of Medicine and Surgery, University of the Philippines. The cases were numbered from 1 to 40.

It is well known that the vertebral artery is one of the largest and most constant branches of the first portion of the subclavian, and that it has a different origin on each side. On the right side the artery arises from the subclavian about 2 centimeters from the origin of the latter from the innominate. On the left side, it arises from the most prominent part of the arch of the subclavian, close to the medial edge of the scalenus anterior muscle. On both sides it first ascends to the foramen transversarium of the sixth cervical vertebra and, having passed that foramen and the foramina of the succeeding cervical vertebræ as high as the epistropheus, it turns laterally and ascends to the foramen of the transverse process of the atlas. From that point it turns backward behind the articular process and, after piercing the posterior occipito-atlantoid membrane and the dura mater, enters the cranium through the foramen magnum. Both vertebral arteries terminate at the lower portion of the pons varolii by anastomosing to form the basilar artery.

While numerous observations on variations in the entrance of the vertebral artery to the foramen transversarium have been recorded, only a few reports on the abnormalities of its origin have been found by me.

Bean, (2) in one hundred twenty-nine cases studied, found only

[1] Read before the IV Asamblea Regional de Médicos y Farmacéuticos de Filipinas, February 5, 1918.

three instances of the abnormality in the origin of the left vertebral artery. In these the vessel arose directly from the arch of the aorta between the left common carotid and the left subclavian. He also found, in the same series, five cases of variation. In every case it arose from a common trunk, from part 1 of the subclavian in association with other arteries; three times with the inferior thyroid; once with the thyroid axis; and in one instance the right vertebral artery was double.

While it is a well-known fact that normally only three branches are given off from the aortic arch, yet there are cases where four or more vessels take origin from it. In the great majority of such instances, according to Thane,(8) the left vertebral artery originates from the arch between the left common carotid and the left subclavian, and only in rare instances between the right common carotid and the right subclavian.

In my series, I found two cases where the left vertebral artery originated from the aortic arch between the left common carotid and the left subclavian. In one instance (case 38) it ascended in front of the transverse processes of the lower cervical vertebræ until it reached the level of the third vertebra, there entering the foramen transversarium. In case 39, after following a similar vertical course, it entered the transverse foramen of the fifth cervical vertebra. The right vertebral artery in both cases was entirely normal (see Plate I, figs. 1 and 2).

Bean's observations, as well as mine, appear to confirm Thane's statement as to the more frequent aortic origin of the left vertebral artery between the left common carotid and the left subclavian.

Thirteen of the remaining cases in my series, while apparently normal in origin, showed abnormalities in the point of entrance to the foramen transversarium. To this number must be added the two cases described above which, besides having abnormal origin, also showed variations in the point of entrance to the transverse foramina.

The cases are classified into two groups; namely, cases showing the same bilateral point of entrance and cases in which the point of entrance differed on both sides.

There were six cases in group 1 (see Table I). In four the arteries entered the transverse foramen of the seventh cervical vertebra; in one, the foramen of the fifth; and in the other, that of the fourth cervical vertebra.

Nine cases were placed under group 2 (see Table II). Here there were five instances where the right artery entered the

normal, or sixth, cervical transverse foramen, and one where the left artery entered the sixth; the three remaining cases were abnormal on both sides.

On comparing figures it was found that my percentage of abnormalities of origin (5 per cent) was slightly higher than that of Bean (2.33 per cent).

Variations in the point of entrance to the transverse foramina were relatively much higher. In my collection of cases there were fifteen such instances, or 37.5 per cent of the cadavers examined. Unilateral variations were almost twice as frequent as bilateral ones; namely, 22.5 per cent and 15 per cent, respectively.

TABLE I.—*Cases where vertebral arteries had the same point of entrance on each side.*

[Six cases, or 15 per cent of those examined.]

Case No.	Cervical vertebra entered.
14	Fourth.
22	Fifth.
1	Seventh.
4	Do.
7	Do.
8	Do.

TABLE II.—*Cases where vertebral arteries had a different point of entrance on each side.*

[Nine cases, or 22.5 per cent of those examined.]

Case No.	Cervical vertebra entered.	
	Right.	Left.
[illegible]	Fourth	Fifth.
[a]32	do	Seventh.
[b]39	Sixth	Third.
[b]38	do	Fifth.
35	do	Do.
37	do	Do.
[a]28	do	Seventh.
31	Seventh	Fifth.
34	do	Sixth.

[a] Vertebral artery enters at higher level on left side. It will be noted that these cases constitute one-third of the total number of cases with different points of entrance.

[b] Left vertebral arteries arise from the aortic arch.

DISCUSSION

The development of the transitory aortic arches of vertebrates was first sketched in the chick by Malpighi, as long ago as 1672, but the earliest work dealing with their development and trans-

formation was done by von Baer(1) in 1827. The last-named author claimed that five pairs of aortic arches were present in the embryos of all vertebrates that developed out of water, but that these were never all present at any one time. Thirty years later Rathke(7) drew up schemes to represent their transformation in Amniota, based upon the assumption that there were only five pairs of these arches represented in the embryonic stage of the higher vertebrates. For a long time the diagrams of Rathke were accepted as standards to represent the history of the development of these arches.

Lehmann(5) says:

> The number of arches recognized by Rathke however was thrown into question by van Bemmelen in 1886, who first pointed out the presence in reptiles and the chick, of a rudimentary arch between the fourth and the supposed fifth. Subsequent observations, notably those of Zimmermann (1889), and Tandler (1902), have led to the recognition of six aortic arches in mammals. The discovery of a rudimentary fifth arch in mammals makes the number of the aortic arches for Amniota the same as in Dipnoi and Amphibia, and establishes an identity, as regards the place of origin of the pulmonary artery in all lung-breathing vertebrates. The diagrams of Boas have accordingly replaced those of Rathke.

Evans,(3) writing in Keibel and Mall's Human Embryology on abnormal aortic branchings, says in part:

> The variations in the great vessels arising from the aortic arch have been known for a long time and could be explained satisfactorily on an embryological basis ever since the work of Rathke. (1843).

To explain my cases of abnormality of origin, it would seem advisable to review the development and transformation of the aortic arches and segmental arteries occurring in normal mammalian embryos (see figs. 1 and 2). In human embryos 4 to 5 millimeters in length five aortic arches are recognized to develop in the following order: First, second, third, fourth, and sixth. The fifth aortic arch is transitory, appearing in embryos 7 millimeters long; it soon degenerates.

Both the descending or dorsal aortæ, between the first and third arches, together with the third aortic arches, give origin to the internal carotid arteries; while the two ventral aortæ, between the third and fourth arches, form the common carotids; those between the first and third arches become the external carotids after the disappearance of the first and second aortic arches. The portion of the dorsal aorta between the third and fourth arches disappears.

The fourth arch, including the short ventral stem between the fourth and sixth arches, becomes the permanent aortic arch

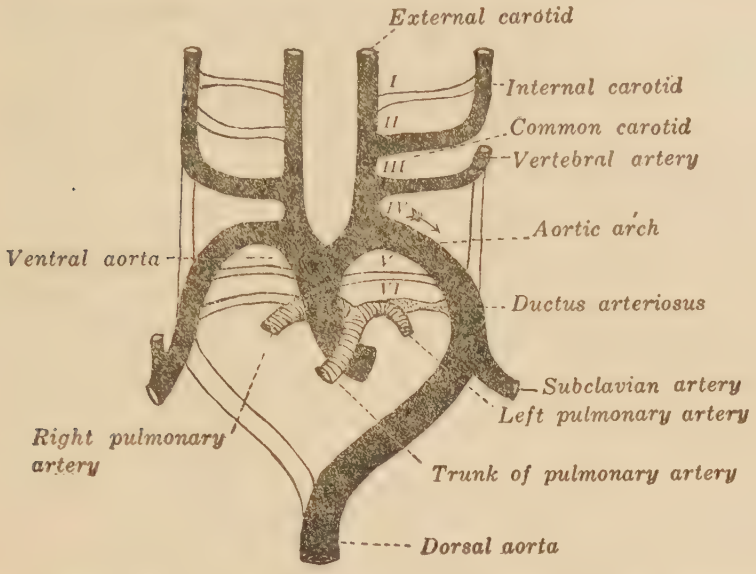

FIG. 1. Diagram, showing the aortic arches and their derivatives in human embryos with normal origin of vertebral arteries (modified after Prentiss).

on the left side, and the innominate and the proximal portion of the subclavian upon the right.

Prentiss(6) says:

The ventral longitudinal anastomosis of the dorsal rami of the first seven pairs of dorsal intersegmental arteries, gives rise to the vertebral

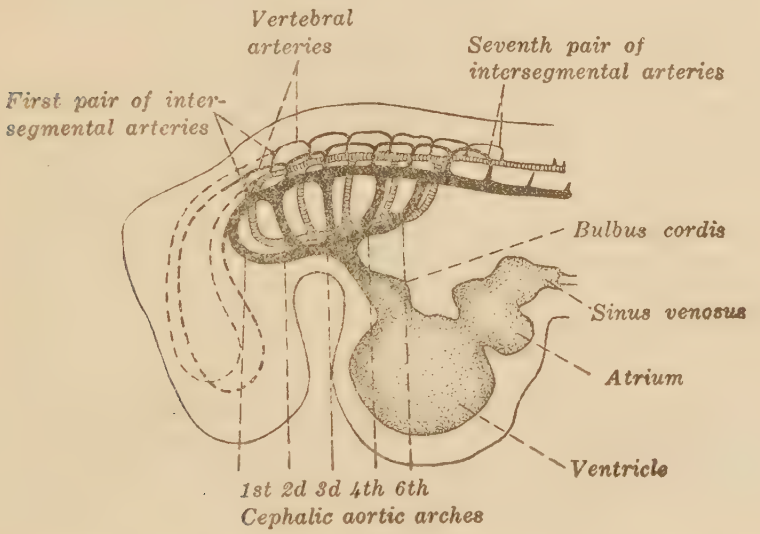

FIG. 2. Diagram, showing stage of five aortic arches and origin of the vertebral arteries (modified after Cunningham).

arteries. The trunks of the first six pairs are lost so that the vertebrals take their origin with the subclavians from the seventh pairs of intersegmental arteries.

Having gained an idea of the normal origin of the vertebral arteries, anatomically and embryologically, three different possibilities would probably account for the abnormal origin of the left vertebral artery as hereinbefore described.

One of the possibilities is the persistence of the second aortic arch in forming the proximal portion of the internal carotid. The ventral aortic stem between the second and third arches takes the place of the left common carotid. The third aortic arch, which eventually becomes the left vertebral artery, shifts downward and laterally comes into direct continuity with the fourth arch, which becomes the future permanent arch of the aorta. Under this possibility it will be seen that the proximal part of the left vertebral artery will be found situated between the left common carotid and the left subclavian artery, as was actually the case in my specimens (see fig. 3).

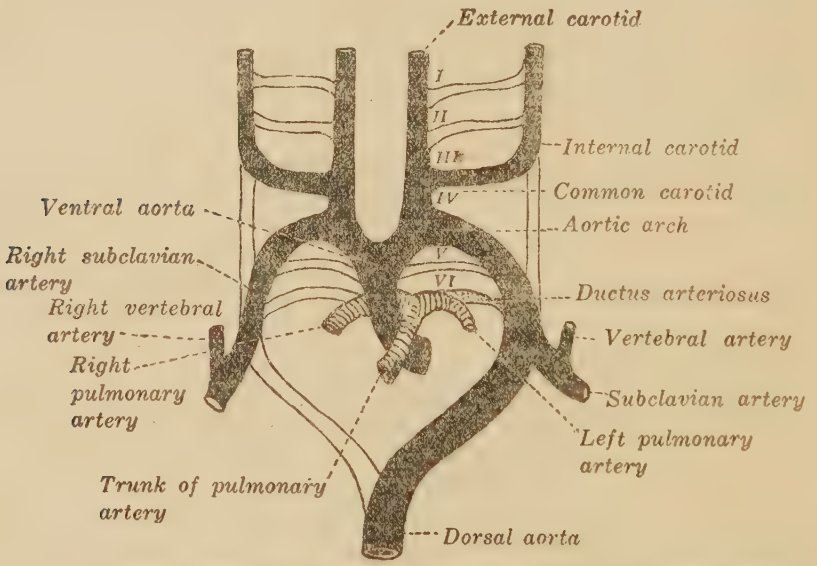

FIG. 3. Diagram, showing one possible abnormal origin of left vertebral artery.

Another not remote possibility would be the persistence of the proximal part of the left dorsal aortic stem between the third and fourth aortic arches and the main trunk of the sixth or one of the more cephalic dorsal intersegmental arteries, the two

together representing the left vertebral artery which, in the final processes of shifting, would come to arise directly from the arch of the aorta between the left common carotid and the left subclavian arteries (see figs. 3 and 4).

A third and last possibility is that the left vertebral artery, instead of arising from the dorsal rami of the seventh intersegmental artery together with the subclavian, originated independently from the sixth intersegmental artery, without the persistence of the proximal part of the dorsal aortic stem between the third and fourth aortic arches if the sixth intersegmental artery was located caudad to them (see figs. 4 and 5).

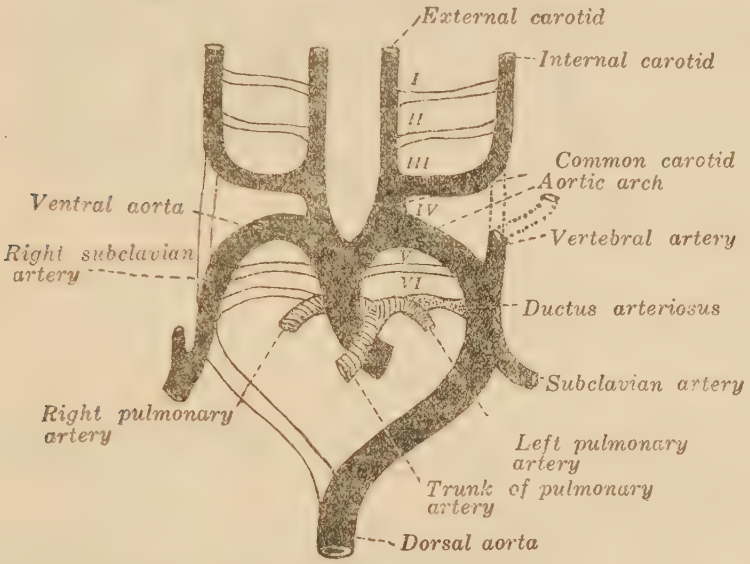

FIG. 4. Diagram, showing another possible abnormal origin of the left vertebral artery.

With regard to the abnormalities in the point of entrance it was found that the foramen transversarium in all the cervical vertebræ below the level of entrance of the vessels was patent.

Keith(4) says that the cervical transverse foramina are produced by perforations of the transverse processes, while still fibrous, by the corresponding intersegmental arteries, the anastomosis of which eventually formed the vertebral artery.

Therefore, in cases where the point of entrance was at an abnormally higher level, it would seem probable that the vertebral artery was formed by fusion of the persisting and corre-

sponding intersegmental artery with the proximal part of the dorsal aortic stem, while the intersegmental arteries below atrophied and disappeared after the formation of the corresponding foramina.

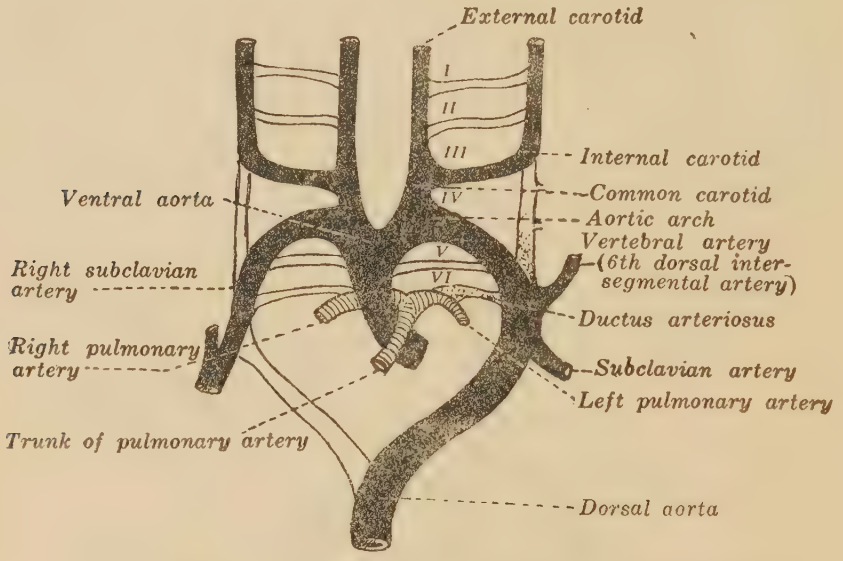

FIG. 5. Diagram, showing possible abnormal origin of left vertebral artery.

SUMMARY

Two of the forty cases showed abnormalities in origin of the vertebral artery; and fifteen, in point of entrance to the foramen transversarium.

My findings confirm those of Bean and Thane with regard to the greater frequency of abnormalities of origin of the vertebral artery in the left side.

Cases of unilateral variations in the point of entrance were almost twice as numerous as the bilateral ones.

My percentages of both abnormalities were higher than those found by Bean.

I am inclined to agree with Bean (p. 313) in ascribing this relatively high percentage of abnormalities of the vertebral artery to the fact that "hybrids tend toward variation." Filipinos undoubtedly must be considered a mixed race.

I wish to acknowledge my indebtedness to Prof. Edward S. Ruth for the helpful suggestions and kindly interest he has given me in this work.

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ILLUSTRATIONS

Plate I

Fig. 1. Diagrammatic sketch, showing abnormalities of origin and point of entrance of left vertebral artery in case 38.
2. Diagrammatic sketch, showing abnormalities of origin and point of entrance of left vertebral artery in case 39.

Text figures

Fig. 1. Diagram, showing the aortic arches and their derivatives in human embryos with normal origin of vertebral arteries (modified after Prentiss).
2. Diagram, showing stage of five aortic arches and origin of the vertebral arteries (modified after Cunningham).
3. Diagram, showing one possible abnormal origin of left vertebral artery.
4. Diagram, showing another possible abnormal origin of the left vertebral artery.
5. Diagram, showing possible abnormal origin of left vertebral artery.

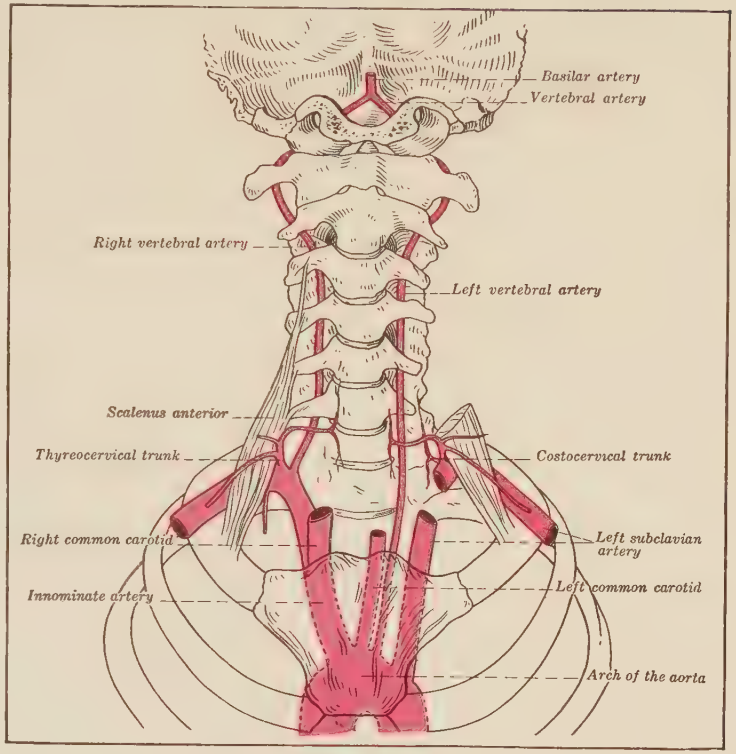

Fig. 1. Left vertebral artery in case 38.

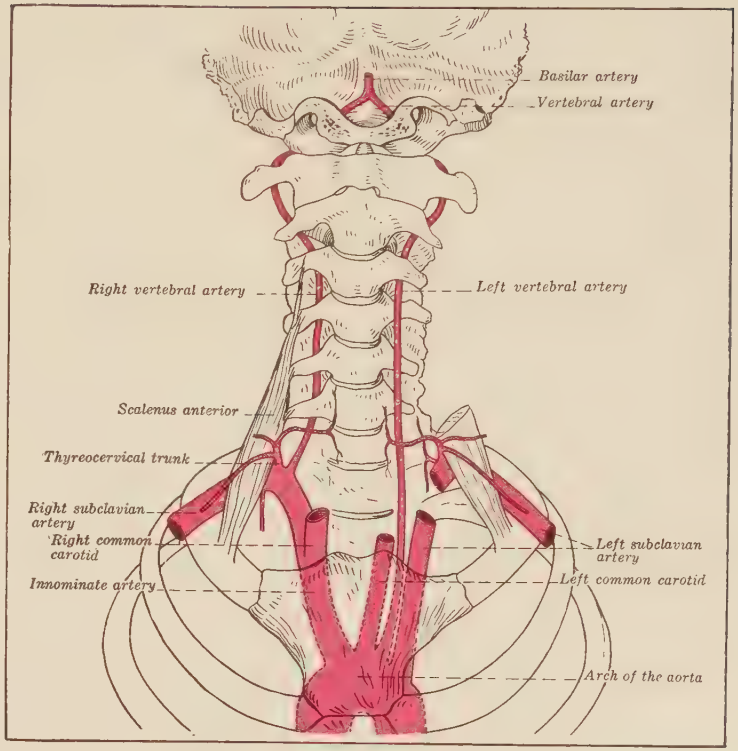

Fig. 2. Left vertebral artery in case 39.

PLATE I.

THE RANCIDITY OF PHILIPPINE COCONUT OIL

By GRANVILLE A. PERKINS

Chemist, Bureau of Science

In a paper entitled The keeping qualities and the causes of rancidity in coconut oil, H. S. Walker [1] called attention to the ravages of mold on moist copra and impure coconut oil, pointing out that [2]

> The action of light and air on coconut oil is of relatively little importance in comparison with the great changes produced by mold growth, and it can be prevented in a large degree by keeping oil receptacles as nearly full as possible, so as to reduce the amount of surface exposed.

He further indicts the molds as follows:[3]

> * * * it seems highly probable that these molds produce a slowly acting enzyme, soluble in oil, which continues its hydrolytic action even after the organisms themselves are dead. This would account for the steady increase in free acid of some commercial oils which are perfectly clear and free from impurities and which have been proven to contain no living bacteria or molds. * * *

In a later paper, The production of free acid in commercial coconut oil on long standing, Walker [4] gives the following conclusions:

> The deterioration of a freshly prepared commercial coconut oil is produced by at least three entirely independent processes and may be divided into two distinct periods of time.
>
> The first, rapid splitting up of the fat, beginning immediately after its expression from copra and continuing for several months up to a year or more according to the nutrive [nutritive] matter present, is occasioned by molds which are either pressed out with the oil together with sufficient sugars and albuminoids for their growth, or, in the case of hot pressed oils, enter the freshly prepared oil from the air. This action continues as long as sufficient nutritive material for mold growth remains in the oil. It may be completely checked by filtration, preferable [preferably] after heating to 100° C. more thoroughly to coagulate albuminoids and to destroy any enzymes already secreted by the molds.
>
> Toward the end of this first period, oxidation by the air sets in and

[1] Philip. Journ. Sci. 1 (1906) 117–172.
[2] Op. cit. 142.
[3] Op. cit. 135.
[4] Philip. Journ. Sci. § A 3 (1908) 126–135.

may continue indefinitely. The rate of this process depends upon the amount of surface exposed to the air, compared with the total volume of oil, and may in extreme cases cause an exceedingly rapid deterioration. It may be entirely prevented by storing the oil in completely filled receptacles, impervious to air.

Along with the two above-mentioned processes, a slight hydrolysis due to heat, moisture and free acids already present is constantly taking place. It may be reduced considerably by filtration, which removes most of the water, together with the organic impurities.

There is reason to believe that some hydrolysis is brought about by enzymes produced by the molds, as unheated oils which have been filtered and rendered antiseptic increase in acidity somewhat more rapidly than do heated ones under the same condtions. However, this distinction is not so apparent after the first year.

Light has apparently no effect on the oxidation by air of coconut oil.

The third and latest paper[5] from the Bureau of Science laboratory on the storage of coconut oil deals chiefly with methods of measuring rancidity. On the subject of the cause of rancidity the authors, besides quoting from Walker and others, make the following observation:[6]

> We believe that the nonfatty material in coconut oil has a profound influence on its character, and experiments are now in progress to test this out.

Regarding the nature of rancidity they state:[7]

> If the formation of rancidity is caused or accompanied by an oxidation, one of the first changes to take place would be the breaking down of the unsaturated acids into simpler acids * * *.

On the same subject Lewkowitsch[8] comes to the following conclusion:

> I therefore define as rancid those oils and fats, the free fatty acids of which have been acted on by the oxygen of the air, in the presence of light. Similar explanations have been given before and the only new element I can claim here would consist in ascribing more emphatically than has been done hitherto the initial phase of rancidity, namely, the hydrolysis, to the accelerating action of enzymes.

The view that light is a necessary condition for rancidity, which Lewkowitsch insists upon, and which he apparently bor-

[5] Brill, H. C., and Parker, H. O., The rancidity of Philippine coconut oil, *Philip. Journ. Sci.* § A 12 (1917) 95–110.

[6] Op. cit. 96.

[7] Op. cit. 108.

[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes. London, Macmillan & Co. 1 (1913) 52.

A more recent text, Edible Oils and Fats, by C. A. Mitchell, London, Longmans, Green & Co. (1918), presents no new data on this subject.

rowed from Ritsert,[9] is obviously at variance with Walker's conclusions.

Lewkowitsch also points out that the chemical nature of the final products of the rancidity process is still an open question. This phase of the subject is beyond the scope of the present investigation.

The purposes of this article are to present evidence as to the relative effect of various factors in the development of rancidity in edible coconut oil, and to point out wherein this evidence leads to a confirmation, modification, or extension of the above-quoted conceptions of rancidity. The rancidity factors studied were: initial acidity, air, light, moisture, enzymes, and nonfatty material. A discussion of these in detail will be taken up following a description of the storage experiments.

STORAGE EXPERIMENTS

Samples for the investigation were prepared by Mr. H. O. Parker, of the Bureau of Science, as follows:

Fresh coconut meat was dried in the laboratory and expressed. About 1 liter of practically colorless but cloudy oil was thus obtained, having an acidity of 0.37 per cent. This will be designated as oil A.

Oil A was divided into six parts, which were treated as described in Table I.

TABLE I.—*Treatment of oil before storage.*

Designation.	Treatment.	Rancidity factors.
1	Filtered clear with fuller's earth	Fat-soluble enzymes.
2	No. 1 stored with 10 per cent water	Fat-soluble enzymes, moisture.
3	No treatment	Fat-soluble and -insoluble enzymes (microörganisms), moisture, nonfatty material.
4	No. 1 sterilized 10 hours at 105° C	None of the above.
5	No. 4 stored with 10 per cent water	Moisture.
6	Sterilized	Moisture and nonfatty material.

By enzymes and microörganisms are meant only such enzymes and microörganisms as may be present in oil obtained as above described. The term nonfatty material refers to the substances —largely protein and carbohydrate—that, together with moisture, give the cloudy appearance to freshly expressed oil, and which are removed by filtration through fuller's earth.

[9] Ritsert, Untersuchung Über d. Ranzigwerden d. Fette, Inaug. Dissert. Berlin (1890).

Each of the six classes of oil A was divided into four parts, of about 30 grams each, and stored March 24, 1917, under the conditions given in Table II.

TABLE II.—*Conditions during storage.*

Designation.	Conditions.	Rancidity factors.
Sd	Sealed, kept in the dark	
Sl	Sealed, kept in the diffused light of the laboratory	Light.
Od	Open, in the dark	Air.
Ol	Open, in the light	Air and light.

The sealed tubes contained practically no air space (about 0.5 cubic centimeter). The open samples were in 100 cubic centimeter bottles closed only with a cotton plug; in these the oil formed a layer 2 centimeters deep. The temperature during storage was about 30° C.

Another sample of oil, B, was prepared in the same manner as oil A, but was found to have only 0.1 per cent acidity. This was divided into six parts as described in Table I. These were stored on April 19, 1917, exposed to air and light, under the same conditions as series Ol of oil A and will, therefore, be designated as series OlB.

On April 11, 1919, the thirty samples were transferred to glass-stoppered bottles and their examination for rancidity was begun. During the time required for the various determinations, which were made in duplicate, the samples were kept as much as possible in a refrigerator to prevent further change. The results of the examination are given in Table III, in which the first twenty-four samples are from oil A, and the remaining six from oil B.

EXPLANATION OF TABLE III

Rancidity factors.—The abbreviations a, l, s, i, m, n, are used to designate air, light, fat-soluble enzymes, fat-insoluble enzymes (together with possible microörganisms), moisture, and nonfatty material, respectively.

Acidity.—The first column gives the determinations made by Parker before storing the oil. Evidently sterilization caused a rise from 0.37 to 0.52 in the case of oil A.

Iodine number.—The Hanus method was used. Duplicates differed by about 0.04. No data on the original iodine numbers were available, but they may be taken as being close to those of the sealed samples, since the latter had no opportunity of

absorbing oxygen. A sample of oil B which had been sealed and kept in the dark had an iodine number of 6.68. Attention is called to the close correspondence between this figure and the figures given for the OlB series in Table III, showing the remarkable resistance to air and light possessed by the unsaturated glycerides in this oil.

TABLE III.—*Rancidity tests on storage samples.*

Sample.	Rancidity factors.	Acidity (as oleic).			Iodine number.	Fuchsine aldehyde reagent.	Oxidizability value.	Odor.
		Original.	Final.	Difference.				
		Per cent.	*Per cent.*	*Per cent.*				
1 Sd	s	0.37	0.62	0.25	6.93	1	0.6	2
2 Sd	s, m	0.37	0.88	0.51	6.94	1	0.6	2
3 Sd	s, i, m, n	0.37	0.79	0.42	6.90	1	1.3	2
4 Sd		0.52	0.63	0.11	6.92	1	1.0	1
5 Sd	m	0.52	0.88	0.36	6.93	1	1.3	2
6 Sd	m, n	0.55	0.81	0.26	6.90	1	1.4	2
1 Sl	l, s	0.37	0.66	0.29	6.86	1	0.7	2
2 Sl	l, s, m	0.37	1.09	0.72	6.93	1	0.6	3
3 Sl	l, s, i, m, n	0.37	0.85	0.48	6.88	1	0.9	2
4 Sl	l	0.52	0.64	0.12	6.92	1	0.8	2
5 Sl	l, m	0.52	1.03	0.51	7.00	1	0.2	3
6 Sl	l, m, n	0.55	0.76	0.21	6.95	1	0.7	2
1 Od	a, s	0.37	0.97	0.60	6.24	5	9.	4
2 Od	a, s, m	0.37	1.11	0.74	6.07	5	10.	4
3 Od	a, s, i, m, n	0.37	0.96	0.59	6.76	3	2.	4
4 Od	a	0.52	0.86	0.34	6.66	4	3.	4
5 Od	a, m	0.52	0.91	0.39	6.32	5	7.	4
6 Od	a, m, n	0.55	1.41	0.86	5.63	5	16.	4
1 O	a, l, s	0.37	1.73	1.4	5.21	5	18.	5
2 Ol	a, l, s, m	0.37	1.84	1.5	5.20	5	17.	5
3 Ol	a, l, s, i, m, n	0.37	1.74	1.4	5.22	5	18.	5
4 Ol	a, l	0.52	1.55	1.0	5.36	5	21.	5
5 Ol	a, l, m	0.52	1.56	1.0	5.38	5	20.	5
6 Ol	a, l, m, n	0.55	2.15	1.6	4.97	5	18.	5
1 OlB	a, l, s	0.1	0.15	0.05	6.71	2	0.0	1
2 OlB	a, l, s, m	0.1	0.11	0.01	6.69	3	1.1	2
3 OlB	a, l, s, i, m, n	0.1	0.21	0.11	6.66	1	0.0	1
4 OlB	a, l	0.1	0.11	0.01	6.68	1	0.5	1
5 OlB	a, l, m	0.1	0.11	0.01	6.61	2	1.0	1
6 OlB	a, l, m, n	0.1	0.18	0.07	6.67	1	1.1	1

Fuchsine aldehyde reagent.[10]—Two grams of fuchsine were dissolved in 100 cubic centimeters of cold saturated aqueous solution of sulphur dioxide. This solution was allowed to stand several hours and then diluted to 2,000 cubic centimeters.

[10] Mullikin, Samuel Parsons, Identification of Pure Organic Compounds 1 (1905) 15.

Equal parts of the oil and the reagent were shaken for five seconds in a test tube and allowed to stand two minutes. The colors so produced were, for purposes of comparison, divided into five classes: 1, pale pink; 2, pale violet; 3, medium violet; 4, deeper violet; 5, intense violet.

Oxidizability value.—This comparatively new determination was used for confirming rancidity in various oils by Issoglio,[11] who states that edible oils and fats give values of from 3 to 10, while a value above 15 indicates rancidity. From the results of Brill and Parker [12] it appears that 15 is much too high for a sweet coconut oil, but that the test has some value.

For the purposes of the present study it was necessary to modify Issoglio's method somewhat, both because the quantities of oil available were insufficient to supply the 20 to 25 grams demanded by his procedure, and because his method, which uses only one-tenth of the distillate for titration, unduly increases the experimental error. The modified determination was as follows:

About 5 grams of oil and 100 cubic centimeters of recently boiled water were placed in a 500 cubic centimeter distilling flask. The side arm of this flask had been bent in the middle at an angle of about 120°, so that when attached to an ordinary Liebig condenser the neck of the flask was inclined, and the first half of the side arm had sufficient slope to allow any mechanically carried oil to drain back into the flask. The flask was heated, and steam, generated from recently boiled water, was passed through at a rate that gave 100 cubic centimeters of distillate in ten minutes. The 100 cubic centimeters of distillate were treated with 10 cubic centimeters of 20 per cent H_2SO_4 and 25 cubic centimeters of 0.02 *N* $KMnO_4$, then heated to boiling, and boiled five minutes in a 300 cubic centimeter Erlenmeyer flask with a small funnel inserted in the neck. An ebullator tube [13] was used, both to keep the temperature constant, and to prevent loss of vapor by bumping. The flask was allowed to cool to about 70°, and 25 cubic centimeters of 0.02 *N* oxalic acid were added. The excess oxalic acid was titrated against $KMnO_4$. The oxidizability value, or the number of

[11] Issoglio, G., Ann. chim. applic. 6 (1916) 1–18. Chem. Abs. 10 (1916) 2943.

[12] Philip. Journ. Sci. § A 12 (1917) 106.

[13] A piece of 5 millimeter tubing, long enough to stand upright in the flask, sealed at the upper end and about 15 millimeters from the lower end.

milligrams of oxygen required to oxidize the distillate from 100 grams of oil, was found by the formula,

$$O = \frac{16\,(N-n)}{W},$$

in which N is the number of cubic centimeters of $KMnO_4$ used, n the cubic centimeters of $KMnO_4$ used in blank test, and W the weight of sample.

Duplicates agreed to about 0.4 for values of less than 4. Large values sometimes varied as much as three units.

Odor.—Oils designated by 1 had fresh coconut odors which had not, however, quite the intensity of the aroma of a freshly prepared pure oil. Oils designated by 2 were difficult to distinguish from those in class 1. They had a suggestion of staleness, but would not be called rancid. The oils in class 3 had been almost deodorized; they had lost their fresh coconut aroma, but had not acquired more of a stale odor than had those in class 2. Samples 2 Sd and 5 Sd were affected in the same way, but to a less extent.

The oils of class 4 were rancid. They varied somewhat among themselves, 3 Od and 4 Od being the best, and 6 Od the worst; but all possessed a slight odor resembling that of stale lard, which distinguished them from classes 1 to 3, but which was not so strong as that of any in class 5. The oils of class 5 had a fairly strong odor of stale lard.

RELATIVE EFFECT OF RANCIDITY FACTORS

Initial acidity.—It appears from Table III that under the conditions of the experiment a difference between 0.1 per cent and 0.37 per cent original acidity had almost as much effect on the keeping qualities of the oil as all the other influences combined. For only one sample of oil A (4 Sd) had an odor preferable to that sample of oil B (2 OlB) which was stored under the least favorable conditions; and, so far as was known, the two oils A and B were practically identical except for their initial acidity.

From the well-known catalytic effect of acids on hydrolysis and the instability of free unsaturated acids as compared to their glycerides we would expect initial acidity to have a marked effect on the formation of more acidity and rancidity, and this is generally considered to be the case. The effect here indicated,

however, is much greater than that indicated by Walker's [14] results on oils of about the same acidity. The question deserves further investigation as the present study can offer but two oils for comparison, and Walker's results are invalidated, as he says, by the variation in exposure to air.

Air.—Table III substantiates the views quoted at the beginning of this article that oxygen is necessary for the development of rancidity but not of acidity. The greater increase of acidity in the open samples was probably due partly to an increased hydrolysis and partly to the breaking up of the oleic acid molecules. The general correspondence of the decrease in the iodine number with the development of rancidity confirms the view quoted from Brill and Parker that the unsaturation of oleic acid offers a point of attack for oxygen in the second stage of rancidity. That this attack is not the initial stage, but is dependent upon some other process, probably hydrolysis, is shown by the remarkable constancy of the iodine number of oil B, even when exposed to air and light.

In this connection a comparison of the decrease in iodine number with the increase of acidity is interesting. A decrease of 1.0 per cent in the iodine number corresponds to the saturation 1.1 per cent of oleic acid. Now in series Od and Ol we have a decrease of iodine number during storage of approximately 0.3 to 2.0 per cent—certainly not less. This corresponds to 0.3 to 2.2 per cent of oleic acid. These calculated values of oleic acid come very close, in each case of series Ol, to the final values found for free acid, but are somewhat less than the final acidity in series Od. In the present state of uncertainty regarding the final products it is difficult to interpret this correspondence. Lewkowitsch [15] seems satisfied that the first stage of rancidity hydrolyzes stearin, palmitin, and olein without selection. If this is true the oxidation (shown by decrease in iodine number) must have attacked *unhydrolyzed olein,* because in the Ol series it affected one-fourth of the total olein present. But Lewkowitsch's prejudice against a possible selective hydrolysis of olein seems based on the experiments of Thum,[16] which are entirely unconvincing, as he merely compared the iodine number of the free fatty acids in each rancid oil to

[14] Philip. Journ. Sci. § A 3 (1908) 133.

[15] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes. London, Macmillan & Co. 1 (1913) 55.

[16] Thum, A., Zeits. f. angew. Chem. (1890) 482 and 483 abs. in Journ. Soc. Chem. Ind. (1891) 70.

that of the acids from the neutral fats in the same oil. It seems probable that the free fatty acids had suffered much more oxidation in the process of rancidity than had the unhydrolyzed glycerides. Hence Thum's experimental data tend to disprove his conclusions. The subject requires further investigation.

Light.—In view of the results shown in Table III, I cannot subscribe to either of the extreme opinions quoted from Lewkowitsch and Walker, respectively, on the influence of light. On the one hand, the samples of series Od, though kept in darkness, all became rancid; on the other hand, exposure to light had a marked effect. It increased hydrolysis even in the sealed samples, and in two of these (2 Sl and 5 Sl), in conjunction with moisture, it caused a complete loss of fresh-coconut odor. In the open samples of oil A it doubled the hydrolysis, more than doubled the decrease in iodine number, and intensified the rancid odor.

Enzymes.—The enzymes mentioned in the quotations from Walker, given early in this article, are those produced by molds. A calculation from his results [17] on the increase of acidity in a sample of oil from moldy copra indicates an enzyme effect in some cases. Fat-soluble enzymes seem to have been responsible for 0.5 per cent acidity increase during the first year and 0.2 per cent during the second. This was in the samples sealed in full bottles. In the half-full bottles no effect can be attributed to fat-soluble enzymes. Practically no effect seems to have been produced by enzymes insoluble in fat.

Lewkowitsch,[18] in placing emphasis on the action of enzymes, calls attention not so much to mold enzymes as to those fat-splitting enzymes which, he says,

> seem to occur in most, if not all, oleaginous seeds, and no doubt play an important part in the utilization of the fatty reserve products stored in the seeds.

The evidence concerning the presence of enzymes in the coconut is somewhat conflicting, but it has been shown in the laboratory [19] of the Bureau of Science that normal coconut meat contains little or no lipase, zymogen, or oxidase. An oxidase was found, however, in coconut *milk*, which accounts for its occasional presence in the oil.

In the present investigation the oils were prepared from fresh, dried coconut meat not appreciably attacked by micro-

[17] Philip. Journ. Sci. § A 3 (1908) 127.
[18] Op. cit. 49.
[19] Brill and Parker, Philip. Journ. Sci. § A 12 (1917) 109.

organisms, thus affording no data concerning enzymes of mold origin. As for the enzymes naturally occurring in coconut meat, it seems evident from Table III that neither the soluble nor the insoluble enzymes played a large part in the deterioration of the oil. A slight effect of the fat-soluble, but not of the fat-insoluble, enzymes may be traced, especially in the column showing the increase in acidity. Unfortunately the enzyme-containing sample must be compared in each case with one of higher initial acidity due to sterilization. In two cases (6 Od and 6 Ol) this higher initial acidity seems to have had a greater effect than the enzymes (3 Od and 3 Ol). On the whole after two years the sterilized oils were little, if any, better than those not sterilized.

Microörganisms.—It has been shown by Walker [20] that, although moldy *copra* is responsible for most of the rancidity in commercial coconut oils, and molds will damage a *turbid* oil, yet *filtered* oils are practically unattacked by microörganisms. Any effect of microörganisms shown in this investigation would be found in the unsterilized oils and would therefore be included in the small enzyme effect previously discussed. But since it is unlikely that any mold or bacterial development took place in the filtered oils, we are limited to the apparent effect of the insoluble enzymes, which was zero. It seems improbable that any of the results were affected by microörganisms.

Moisture.—The samples of dry oil sealed in glass tubes (1 Sd, 4 Sd, 1 Sl, and 4 Sl) showed an acidity increase of 0.1 to 0.3 per cent. Theoretically this hydrolysis required about 2 to 6 milligrams of water per 30-gram sample. Such small amounts of water may have been present in the oil when sealed, or they may have been formed by decomposition of substances in the oil other than glycerides. When a large excess of water was added the acidity increase was 0.4 to 0.7 per cent, and a deodorization was observed, especially in the samples exposed to light.

In the open samples moisture conditions did not differ much, for all were exposed to normal atmospheric moisture and, on the other hand, all added water evaporated. It must have remained longer in the samples in the dark and assisted in the oxidation, as is evident from the iodine numbers.

Nonfatty material.—Examining Table III for the effect of nonfatty material I fail to find any "profound influence." There appears a very slight effect in 3 OlB and 6 OlB, and 6

[20] Philip. Journ. Sci. 1 (1906) 134 and § A 3 (1908) 127.

Od and 6 Ol show a combined effect of increased initial acidity and nonfatty material which is noticeable.

CONCLUSIONS

Modifying somewhat the conceptions of rancidity outlined at the beginning of this article I submit the following conclusions:

In the type of rancidity of coconut oil studied the first stage is a hydrolysis, the rapidity of which varies with the initial acidity and the amount of moisture present. Exclusive of any mold action, this hydrolysis may be somewhat accelerated by the action of air, light, and a fat-soluble enzyme.

The second stage of rancidity is an oxidation of the free fatty acids. Possibly this involves also the oxidation of unhydrolyzed olein, but the amount of oxidation is dependent on the amount of hydrolysis.

The oxidation is hastened by light and moisture, but light is not a necessary condition.

CHEMICAL METHODS FOR THE MEASUREMENT OF RANCIDITY

The above conclusions are restricted to the type of rancidity studied. Though this appears to be the common type in coconut oil, the possibility of others is not excluded. Walker [21] describes a "peculiar, pungent, 'strong' odor in otherwise pure oils." I have also observed peculiar odors which the remnants of samples 3 Sd and 5 Sd, not used for analysis, developed during storage for several weeks in a very damp refrigerator. Sample 5 Sd, which developed an odor resembling Roquefort cheese, was found to contain a slight growth of mold, identified by Dr. H. S. Yates, of the Bureau of Science, as a species of *Torula*. No microörganism was found in sample 3 Sd, but it developed a peculiar, acrid odor. When both of these odors had become readily noticeable little or no change could be found in the oxidizability value, fuchsine aldehyde test, or iodine number. The acidity of 3 Sd was 0.87, and that of 5 Sd, 0.95 per cent, only 0.08 and 0.07, respectively, higher than the values previously found.

Such peculiar types of rancidity indicate that a single chemical test cannot be expected to enable one to distinguish between edible and nonedible coconut oils. In the ordinary type of rancidity, however, occurring under the conditions of our investigation, it appears that the decrease in iodine value, the fuchsine aldehyde test, and the oxidizability number give good indica-

[21] Walker, H. S., Philip. Journ. Sci. 1 (1906) 139.

tions of the amount of deterioration. The iodine number alone, without some data on the original number, has no value. The acidity is a measure of the first stage in the rancidity process.

SUMMARY

Two-year storage tests were made on thirty samples of edible coconut oil. The results were in general agreement with the accepted views of rancidity and its causes. The action of light was found to be a powerful, but not necessary, factor in the production of rancidity. Enzymes from the fresh coconut meat had some effect on the keeping qualities of the oil, but sterilization was of doubtful benefit.

An oil of low initial acidity remained sweet during two years' exposure to air and light.

The measurement of rancidity is discussed briefly.

THE GENUS GORDONIA IN THE PHILIPPINE ISLANDS

By I. H. Burkill

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By the kindness of Mr. E. D. Merrill, I have recently had the loan of the gordonias in the herbarium of the Bureau of Science, Manila. I find five Philippine forms among them, which for the present I call species, though other authors may perhaps not concede more than varietal rank to one, or possibly even two, of them. First of all, there is *Gordonia luzonica* Vidal, a tree so common in the mountains north of Manila Bay that every collector gets it. From these mountains it extends southward, certainly to Negros, and perhaps to Mindanao. Next, in the Mountain Province and in Sorsogon Province, there is a tree with leaves exactly similar, but with a subclavate capsule. This is a form which may be no more than a variety of *G. luzonica.* Thirdly, in the northern part of Luzon, there is the species (*Curran 5083*) to which I previously called attention, under *G. luzonica,*[1] with larger leaves and capsules and with a considerable amount of hair upon the midrib on the lower surface of the leaves. Fourthly, on Mount Polis, which is also in northern Luzon, there is a species clearly distinct in flowers and capsules from all other Philippine forms. Lastly, there is a montane plant with entire leaves on Mount Sablayan, Mindoro.

I propose to name these, respectively, (1) *Gordonia luzonica,* (2) *G. subclavata,* (3) *G. benguetica,* and (4) *G. polisana,* leaving the fifth without a name because it is too imperfectly known.

Key to the Philippine Gordonias.

a^1. Leaves dentate.

b^1. Leaves narrowed to the acumen, about one-third as broad as long.

c^1. Capsules 3 to 4 cm long, thickest below the middle, pyramidal at the top..... 1. G. luzonica.

c^2. Capsules 4 cm long, subclavate, the top domed..... 2. G. subclavata.

b^2. Leaves rounded under the acumen, about one-half as broad as long.

c^3. Leaves broadest at the middle; capsule 4 cm long.

3. G. benguetica.

[1] Journ. Straits Branch Roy. Asiat. Soc. 76 (1917) 150.

c^2. Leaves broadest above the middle; capsule long-tapering. 4. G. polisana.

a^2. Leaves entire..... 5. G. sp. (*Merritt 9757*).

It will be observed that I have not included *G. welborni* Elmer, from Negros, because I see no difference between it and *G. luzonica*, nor *G. fragrans* Merr., which Mr. Merrill has already reduced to the same species.[2]

Gordonia luzonica in the Manila herbarium is represented from Mount Mariveles, Bataan Province, by the following specimens: *Merrill 3732, Whitford 305, For. Bur. 809 Borden, Williams 747, For. Bur. 236 Meyer,* and *For. Bur. 6229 Curran,* collected at varying heights between 600 and 1,500 meters above sea level. The trees are recorded as from 6 to 20 meters high with a diameter at breast height of 30 to 100 cm. Meyer states that it is very common. Evidently it occurs as isolated individuals upon ridges and exposed slopes. Just north of Bataan, in Zambales Province, Ramos collected it as a rather small tree at Tapotas, *Bur. Sci. 5091 Ramos.* In Laguna Province it occurs at Paete, *Bur. Sci. 5077 McGregor* and *Bur. Sci. 10029 Ramos;* at Papatakem, *Merrill Phil. Pl. 428, coll. Ramos,* and on Mount Banahao, *Bur. Sci. 27939 Ocampo.* The recorded altitudes vary from 100 to 1,376 meters. The height recorded for the trees is from 28 to 30 meters with a diameter at breast height up to 117 cm. It was also collected on Mount Banahao by Vidal, the altitude given as 600 to 1,000 meters. The Cuernos Mountains where Mr. Elmer secured his *G. welborni, Elmer 9584,* are in the southern part of Negros; Mount Silay where Mr. Whitford has gathered the species (*No. 1499*) is in the northern part of the same island. The altitude on Mount Silay is recorded as 1,044 to 1,135 meters; that on the Cuernos Mountains as 1,300 meters. Mr. Elmer records trees as reaching the height of 50 meters, or 160 feet. The statement that this species occurs in Mindanao rests upon fallen corollas only, and therefore is not to be reckoned as well founded. These fallen corollas were picked up by Mrs. Clemens at Camp Keithley on Lake Lanao.

The flowering period of *G. luzonica* must be as extended as is that of the Singapore gordonias. On Mount Mariveles flowers have been secured in January, February, and March; in Laguna Province, in May, July, and August; in Negros, in May and June; and in Mindanao, in July. The flowers are white and fragrant.

[2] Philip. Journ. Sci. 3 (1908) Bot. 114.

Gordonia luzonica has been too little collected in fruit; and, though there is a slightly different facies about *G. subclavata,* the line between them needs defining upon more ample material than is now available.

Gordonia subclavata was collected at Bauco, Bontoc Subprovince, by *Vanoverbergh* (*No. 1465*), with fruit, in September or October; and by *Ramos* (*Bur. Sci. 23391*) on Mount Lalao, Sorsogon Province, with fruit, in August. The two localities are far apart; but the specimens are an exact match. The altitude at which the first was collected is 1,700 meters and that of the second about 300 meters. The height of the tree in the first is recorded as 3 or 4 meters; in the second, as about 20 meters.

As stated above, *Gordonia benguetica* has been collected but once. This was at Baguio along a stream depression at an altitude of about 1,200 meters. The tree was 4 meters high, and had flower buds as well as ripe capsules. The leaves are large, exactly rounded above under the mucro, and conspicuously toothed along the margins; the veins are fairly evident to the eye, while the midrib at the back, especially toward the base, is clothed with silky hairs. It is very desirable that more material of this species be collected; for, although the shape of the leaf is so distinct from that of *G. luzonica* as to render it impossible to look upon it—a small tree—as immature *G. luzonica,* one gathering is less than is desirable for the defining of the species.

Gordonia polisana is a quite distinct species. It has been collected twice upon Mount Polis in Bontoc Subprovince, *For. Bur. 18384 Alvarez,* and *Sandkuhl 316,* both times in the month of January, and both times with flowers. These flowers are very large—Mr. Sandkuhl says 11 to 14 cm across—and dried they measure 9 cm. The flowers are white. The tree is recorded as from 10 to 15 meters high, and as growing in the mossy forest or just below it from 1,500 to 1,600 meters' altitude. A broken-up capsule was secured by Sandkuhl, and it is obvious that it tapers gradually after the manner of *G. penangensis.*

The remaining species, that represented by *For Bur. 9757 Merritt,* has rather small entire leaves and the appearance of having been wind swept. Doubtless it occurs on the margin of stunted vegetation, although the altitude is given as 1,000 me-

ters. Buds are present upon the specimen, which was collected in the month of March.

1. **GORDONIA LUZONICA** Vidal Rev. Pl. Vasc. Filip. (1886) 57.

Gordonia fragrans Merrill in Philip. Journ. Sci. 1 (1906) Suppl. 95.
Gordonia welborni Elmer, Leafl. Philip. Bot. 2 (1908) 501.

Arbor ad 50 m alta. Folia oblongo-lanceolata, triplo longiora quam latiora, in petiolo brevi angustata, in acumen gradatim acuminata, maturitate clava. Flores ad 5 cm diametro. Capsulae 3 ad 4 cm longae, infra medium crassiores, apice pyramidales.

Crescit in montibus insularum Luzon, Negros et forsan Mindanao, locis plurimis.

2. **GORDONIA SUBCLAVATA** sp. nov., vel forsan praecedentis varietas.

Arbor ad 20 m alta. Folia oblongo-lanceolata, triplo longiora quam latiora, in petiolo brevi angustata, in acumen gradatim acuminata, maturitate calva. Flores ad 5 cm diametro. Capsulae 4 cm longae, supra medium crassiores, apice hemisphaericae.

Crescit in montibus subprovinciae Bontoc ad Bauco, et provinciae Sorsogon in monte Lalao, insulae Luzon.

3. **GORDONIA BENGUETICA** sp. nov.

Arbor ad 4 m alta. Folia late elliptica, duplo longiora quam latiora, versus petiolum brevem cuneata, versus acumen rotundata, infra in nervo medio pubescentia. Flores igniti. Capsulae 4 cm longae, ad medium vel infra medium crassiores, apice pyramidales.

Crescit in valliculis montium prope Baguio, insulae Luzon.

4. **GORDONIA POLISANA** sp. nov.

Arbor ad 15 m alta. Folia obovata vel elliptico-obovata, duplo longiora quam latiora, sessilia, versus insertionem cuneata, versus acumen rotundata, maturitate calva. Flores ad 9 vel ad 14 cm diametro. Capsulae 4 cm longae, angustae, acutae.

Crescit in monte Polis, districtu Ifugao, insulae Luzon.

5. **GORDONIA** sp.

Arbor ad 12 m alta. Folia fere exacte elliptica vel elliptico-obovata, integra, in petiolo brevi angustata, sub acumine rotundata, maturitate calva. Flores, ut dicitur, virides.

Collegit M. L. Merritt sub numero 9757 in Monte Sablayan, insulae Mindoro.

HIGHER BASIDIOMYCETES FROM THE PHILIPPINES AND THEIR HOSTS, I

By O. A. Reinking

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An attempt has been made to collect the higher Basidiomycetes of the Philippine Islands from known hosts. Few collections of the fleshy and woody fungi in the Philippines or in other countries have been made with a view to determining the trees attacked. Miscellaneous collections of such fungi are currently made by dumping them into a sack and later separating them and sending them away for determination. While it is absolutely impossible to give the hosts in each instance, because of their decayed condition, determination of a large number of species was accomplished by examination of wood sections. I am indebted to the Bureau of Forestry for the majority of the wood determinations. In a study of forest-tree- and timber-destroying fungi, it is of the utmost importance first to become acquainted with the flora in the forest and then to know whether or not a particular fungus is confined to a definite plant. A survey of these fungi has shown that the vast majority found on dead wood are not confined to specific plants. Most of the species will grow equally well on a large number of woods. The parasitic ones apparently are more apt to be confined to definite hosts.

The species of this list are grouped, in so far as possible, according to the classification of Engler and Prantl with the host and the collector under each class of fungus. The numbers refer to the College of Agriculture fungus herbarium. The collections have been made on Mount Maquiling and in the vicinity of Los Baños, Laguna Province, Luzon, in Mindanao, and in Sulu, either by me or by my students under my direction as indicated in the text. The identifications of the fungi in this list were made by N. Patouillard, of Neuilly sur Seine, France.

AURICULARIACEAE

AURICULARIA Bulliard

AURICULARIA AURICULA-JUDAE (L.) Schroet.

Furcraea gigantea Vent., Mount Maquiling, *Reinking 1917*, on dead leaves.

AURICULARIA MESENTERICA (Dicks.) Fries.

Celtis philippensis Blanco, Mount Maquiling, *Collado 1418*, on dead branches.

Cordia myxa L., Mount Maquiling, *Collado 1807*, on dead branches.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1876*, on dead stump.

Premna odorata Blanco, Mount Maquiling, *Lontok 1020*, on dead branches.

Theobroma cacao L., Los Baños, *Baybay 759*, on dead branches.

AURICULARIA POLYTRICHA (Mont.) Saccardo.

Aleurites moluccana (L.) Willd., *Collado 48*, on dead branches.

Castilloa elastica Cerv., Basilan, Isabela, *Reinking 2081, 2077*, on dead logs and branches.

Cordia myxa L., Mount Maquiling, *Collado 70*, on living bark.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2060*, on dead branches.

Mangifera indica L., Los Baños, *Marquez 255, Hernandez 840, 957*, on dead branches.

Parkia javanica (Lam.) Merr. (*Parkia roxburghii* G. Don), Mount Maquiling, *Leaño 601*, on living bark.

AURICULARIA TENUIS Léveillé.

Columbia serratifolia (Cav.) DC., Mount Maquiling, *Collado 1453*, on dead stem.

Cratoxylon sp., Mount Maquiling, *Collado 1374*, on dead branches.

Diospyros sp., Mount Maquiling, *Collado 1470*, on dead branches.

Diplodiscus paniculatus Turcz., Mount Maquiling, *Collado 1342*, on dead branches.

Ficus sp., Mount Maquiling, *Collado 1426*, on dead branches.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1414*, on dead branches.

Meliaceae indet., Mount Maquiling, *Reinking 90*, on dead branches.

Parinarium sp., Mount Maquiling, *Collado 71,* on dead branches.

Psidium guajava L., Mount Maquiling, *Collado 51,* on dead branches.

Pterocarpus sp., Mount Maquiling, *Collado 1434,* on dead branches.

TREMELLACEAE

HETEROCHAETE Patouillard

HETEROCHAETE TENUICULA (Lév.) Patouillard.

Cajanus cajan (L.) Millsp., Mount Maquiling, *Reinking 1938,* on dead branches.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2032,* on dead branches.

Siphonodon celastrineus Griff., Mount Maquiling, *Alcasid 265, 266,* on dead branches.

DACRYOMYCETACEAE

GUEPINIOPSIS Patouillard

GUEPINIOPSIS SPATHULARIUS (Schw.) Patouillard.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes), Los Baños, *Pañganiban 356,* on dead culm.

THELEPHORACEAE

HYMENOCHAETE Léveillé

HYMENOCHAETE ADUSTA (Lév.) Bresadola.

Mount Maquiling, *Collado 131,* on decaying log.

HYMENOCHAETE ATTENUATA Léveillé.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1474,* on dead branches.

HYMENOCHAETE PAVONIA Patouillard.

Antidesma bunius (L.) Spreng., Los Baños, *Estrebillo 650,* on living leaves.

HYMENOCHAETE PERPUSILLA Patouillard.

Heritiera littoralis Dry., Mount Maquiling, *Cabanos 784,* on living leaves.

CLADODERRIS Persoon

CLADODERRIS DENDRITICA Persoon.

Ficus sp., Mount Maquiling, *Collado 1480,* on dead stems.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2037,* on dead stems.

Los Baños, *Marquez 1085,* on the ground.

POLYPORACEAE

GANODERMA Karsten

GANODERMA LUCIDUM (Leys.) Karsten.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes), Mount Maquiling, *Collado 2349*, on dead stems.

GANODERMA LUCIDUM (Leys.) Karst. var. **LACCATUM** Patouillard.

Dracontomelum dao Merr. et Rolfe, Mount Maquiling, *Reinking 2080*, on living roots.

POLYPORUS Micheli

POLYPORUS LIGNOSUS (Kl.) Bresadola.

Ficus sp., Mount Maquiling, *Catalan 2345*, on dead stems.

POLYPORUS RUGULOSUS Léveillé.

Mangifera indica L., Laguna Province, San Antonio, *Hernandez 1089*, on dead stems.

Theobroma cacao L., Mount Maquiling, *Sobrepeña 1180*, on dead stems.

TRAMETES Fries

TRAMETES ASPERA (Jungh.) Bresadola.

Elaeocarpus sp., Mount Maquiling, *Collado 1452*, on dead branches.

Ficus sp., Mount Maquiling, *Collado 1392*, on dead stems.

TRAMETES BADIA Berkeley.

Parkia javanica (Lam.) Merr. (*P. roxburghii* G. Don), Mount Maquiling, *Leaño 602*, on dead wood.

TRAMETES FLAVA (Jungh.) Patouillard.

Terminalia comintana Merr., Mount Maquiling, *Collado 94*, on dead stems.

TRAMETES PERSOONII Montagne.

Aleurites moluccana (L.) Willd., Mount Maquiling, *Collado 52*, on dead branches.

Antiaris sp., Mount Maquiling, *Collado 1466*, on dead branches.

Ficus sp., Mount Maquiling, *Collado 730*, on dead stems.

Ficus religiosa L., Mount Maquiling, *Pañganiban 310*, on dead branches.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2034, 2035*, on dead branches.

Pterocymbium tinctorium Merr., Mount Maquiling, *Collado 50*, on dead stems.

TRAMETES SCOPULOSA (Berk.) Bresadola.

Ficus sp., Mount Maquiling, *Collado 1462,* on dead stems.

LENZITES Fries

LENZITES APPLANATA Fries.

Prosopis vidaliana Naves, Mount Maquiling, *Lontok 2310,* on dead stems.

LENZITES PALISOTI Fries.

Acacia farnesiana (L.) Willd., Mount Maquiling, *Collado 45,* on dead stems.

Celtis philippensis Blanco, Mount Maquiling, *Collado 1418,* on dead stems.

Ficus sp., Mount Maquiling, *Collado 2346,* on dead wood.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 2348,* on dead stems.

Mallotus sp., Mount Maquiling, *Collado 1482,* on dead stems.

Mangifera indica L., Los Baños, *Hernandez 929,* on dead stem.

Parkia javanica (Lam.) Merr. (*P. roxburghii* G. Don), Mount Maquiling, *Leaño 1011,* on dead bark.

LENZITES PLATYPHYLLA Léveillé.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes), Los Baños, *Marquez 256,* on dead stems.

LENZITES TENUIS Berkeley.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes), Los Baños, *Collado 1837,* on dead culm.

Leucaena glauca (L.) Benth., Los Baños, *Collado 1854,* on dead branches.

Musa sapientum L., Los Baños, *Reyes 2358,* on partly dead leaf.

HEXAGONA Fries

HEXAGONA THWAITESII Berkeley.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2021,* on dead branches.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1456,* on dead branches.

Macaranga tanarius (L.) Muell.-Arg., Mount Maquiling, *Navera 794,* on dead twig.

Mangifera indica L., Mount Maquiling, *Torres 1188, Hernandez 960,* on dead branches.

HEXAGONA THWAITESII Berk. var. **RETROPICTA** Bresadola.

Parkia javanica (Lam.) Merr. (*P. roxburghii* G. Don), Mount Maquiling, *Reinking 1999,* on dead wood cuttings.

FAVOLUS Fries

FAVOLUS PHILIPPINENSIS Berkeley.

Mallotus sp., Mount Maquiling, *Collado 1396*, on dead branches.

FAVOLUS SPATHULATUS (Jungh.) Bresadola.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes), Mount Maquiling, *Albano 589*, on dead culms.

FAVOLUS TENER Léveillé.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking 2070*, on dead branch.

CYCLOMYCES Kunze

CYCLOMYCES CICHORIACEUS (Berk.) Patouillard.

Psidium guajava L., Mount Maquiling, *Collado 1384*, on dead branches.

CYCLOMYCES TABACINUS (Mont.) Patouillard.

Quercus sp., Mount Maquiling, *Collado 41, 43, 1488*, on dead branches.

LEUCOPORUS Quelet

LEUCOPORUS GALLO-PAVONIS (Berk.) Patouillard.

Ficus sp., Mount Maquiling, *Collado 1469*, on dead branches.

LEUCOPORUS GRAMMOCEPHALUS (Berk.) Patouillard.

Columbia serratifolia (Cav.) DC., Mount Maquiling, *Collado 1443*, on dead branches.

MELANOPUS Patouillard

MELANOPUS GUILFOLEYI (Berk.) Patouillard.

Mount Maquiling, *Collado 1476*, on dead wood.

MICROPORUS Palisot de Beauvois

MICROPORUS AFFINIS (Nees) Patouillard.

Dillenia sp., Mount Maquiling, *Collado 1358*, on dead branches.
Trema sp., Mount Maquiling, *Collado 1454*, on dead branches.

MICROPORUS CRENATUS (Berk.) Patouillard.

Mount Maquiling, *Collado 138*, on bark of a tree.

MICROPORUS MICROLOMA (Lév.) Patouillard.

Cordia sp., Mount Maquiling, *Ricafrente 1366*, on dead branches.

MICROPORUS SANGUINEUS (Lév.) Patouillard.

Alstonia macrophylla Wall., Mount Maquiling, *Collado 1458*, on dead branches.

Koordersiodendron pinnatum Merr., Mount Maquiling, *Collado 1494*, on dead branches.

Mangifera indica L., Mount Maquiling, *Collado 1338*, on dead branches.

MICROPORUS XANTHOPUS (Fr.) Patouillard.

Aleurites moluccana (L.) Willd., Mount Maquiling, *Collado 84*, on decaying wood.

Cratoxylon sp., Mount Maquiling, *Collado 1347*, on dead branches.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 774*, on dead branches.

Morus alba L., Mount Maquiling, *Collado 140*, on dead branches.

Psidium guajava L., Mount Maquiling, *Collado 1834*, on dead branch.

Quercus sp., Mount Maquiling, *Collado 1364*, on dead branches.

CORIOLUS Quelet

CORIOLUS HIRSUTUS (Fr.) Quelet.

Cassia grandis L., Mount Maquiling, *Dario 1163*, on dead branches.

Litsea sp., Mount Maquiling, *Reinking 1471*, on dead branches.

Mangifera caesia Jack, Jolo Provincial School Nursery, *Reinking 2160*, on dead branches.

Parashorea plicata Brandis, Mount Maquiling, *Collado 1499*, on dead branches.

Parkia javanica (Lam.) Merr. (*P. roxburghii* G. Don), Mount Maquiling, *Collado 1339*, on dead branches.

AGARICACEAE

SCHIZOPHYLLUM Fries

SCHIZOPHYLLUM COMMUNE Fries.

Bauhinia sp., Mount Maquiling, *Collado 89*, on dead stem.

Castilloa elastica Cerv., Basilan, Isabela, *Reinking 2075*, on dead branches.

Celtis philippensis Blanco, Mount Maquiling, *Collado 1413*, on dead branches.

Hevea brasiliensis (HBK) Muell.-Arg., Basilan, Isabela, *Reinking, 2040, 2049,* on dead stump.

Ipomoea batatas (L.) Poir., Mindanao, Momungan Colony, *Reinking 2095,* on dead root.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1420, 1436, Navera 258,* on dead branches.

Luffa cylindrica Roem., Los Baños, *Bautista 305,* on living stems.

Mangifera indica L., San Antonio, *Hernandez 1049,* on dead branches.

Musa sapientum L., San Antonio, *Reyes 746,* on dead leaf sheath.

Prosopis vidaliana Naves, Mount Maquiling, *Lontok 944, 1067,* on dead branches.

Saccharum officinarum L., Mount Maquiling, *Serrano 1039, Pañganiban 343,* on dead stems.

Sapium merrillianum Pax et K. Hoffm., Mount Maquiling, *Collado 1404,* on dead branches.

Schizostachyum sp., Mount Maquiling, *Albano 831,* on dead stem.

Tamarindus indica L., Mount Maquiling, *Alcasid 495,* on dead branches.

Zea mays L., Mount Maquiling, *Bautista 365,* on dead stem.

LENTINUS Fries

LENTINUS CONNATUS Berkeley.

Mount Maquiling, *Collado 112, 1464,* on decaying log.

LENTINUS DACTYLIOPHORUS Léveillé.

Mount Maquiling, *Collado 1838,* on decaying log.

LENTINUS DICHROUS Léveillé.

Mount Maquiling, *Collado 1360, 1386,* on dead wood.

LENTINUS EXILIS Klotzsch.

Bambusa spinosa Roxb. (*Bambusa blumeana* Schultes). Mount Maquiling, *Collado 508,* on dead culm.

MARASMIUS Fries

MARASMIUS PILOPUS Kalchbrenner.

Mallotus sp., Mount Maquiling, *Collado 1406,* on dead branches.

CRINIPELLIS Patouillard

CRINIPELLIS GALEATUS (Berk. et Curt.) Patouillard.

Citrus nobilis Lour., Los Baños, *Lindayag 990,* on dead stem.

CRINIPELLIS STIPITARIUS (Fr.) Patouillard.

Mount Maquiling, *Collado 1350,* on dead wood.

LYCOPERDACEAE

LYCOPERDON Tournefort

LYCOPERDON POLYMORPHUM Vittadini.

Arenga pinnata (Wurmb) Merr. (*Arenga saccharifera* Labill.), Mount Maquiling, *Peralta 201,* on dead parts.

LYCOPERDON ROSEUM Zoll.

Leucaena glauca (L.) Benth., Mount Maquiling, *Collado 1420,* on dead branches.

Memecylon sp., Mount Maquiling, *Bautista 1328,* on dead stem.

GEASTER Micheli

GEASTER VELUTINUS Lloyd.

Mount Maquiling, *Cazeñas 796,* on dead wood.

FUNGI LISTED ACCORDING TO HOSTS

ACACIA FARNESIANA (L.) Willd.
Lenzites palisoti Fr., dead branches.
ALEURITES MOLUCCANA (L.) Willd.
Auricularia polytricha (Mont.) Sacc., dead branches.
Microporus xanthopus (Fr.) Pat., decaying wood.
Trametes persoonii Mont., dead branches.
ALSTONIA MACROPHYLLA Wall.
Microporus sanguineus (Lév.) Pat., dead branches.
ANTIARIS sp.
Trametes persoonii Mont.
ANTIDESMA BUNIUS (L.) Spreng.
Hymenochaete pavonia Pat., living leaves.
ARENGA PINNATA (Wurmb) Merr. (*Arenga saccharifera* Labill.).
Lycoperdon polymorphum Vitt., dead parts.
BAMBUSA SPINOSA Roxb. (*Bambusa blumeana* Schultes).
Favolus spathulatus (Jungh.) Bres., dead culms.
Ganoderma lucidum (Leys.) Karst., dead culm.
Guepiniopsis spathularius (Schw.) Pat., dead culm.
Lentinus exilis Kl., dead culm.
Lenzites platyphylla Lév., dead culm.
Lenzites tenuis Berk., dead culm.

BAUHINIA sp.
Schizophyllum commune Fr., dead stem.

CAJANUS CAJAN (L.) Millsp.
Heterochaete tenuicula (Lév.) Pat., dead branches.

CASSIA GRANDIS L.
Coriolus hirsutus (Fr.) Quel., dead branches.

CASTILLOA ELASTICA Cerv.
Auricularia polytricha (Mont.) Sacc., dead log.
Schizophyllum commune Fr., dead branches.

CELTIS PHILIPPENSIS Blanco.
Auricularia mesenterica (Dicks.) Fr., dead branches.
Lenzites palisoti Fr., dead branches.
Schizophyllum commune Fr., dead branches.

CITRUS NOBILIS Lour.
Crinipellis galeatus (B. et Curt.) Pat., dead stem.

COLUMBIA SERRATIFOLIA (Cav.) DC.
Auricularia tenuis Lév., dead stem.
Leucoporus grammocephalus (Berk.) Pat., dead branches.

CORDIA sp.
Microporus microloma (Lév.) Pat., dead branches.

CORDIA MYXA L.
Auricularia mesenterica (Dicks.) Fr., dead branches.
Auricularia polytricha (Mont.) Sacc., bark of living tree.

CRATOXYLON sp.
Auricularia tenuis Lév., dead branches.
Microporus xanthopus (Fr.) Pat., dead branches.

DILLENIA sp.
Microporus affinis (Nees) Pat., dead branches.

DIOSPYROS sp.
Auricularia tenuis Lév., dead branches.

DIPLODISCUS PANICULATUS Turcz.
Auricularia tenuis Lév., dead branches.

DRACONTOMELUM DAO (Blanco) Merr. et Rolfe.
Ganoderma lucidum (Leys.) Karst. var. *laccatum* Pat., living roots.

ELAEOCARPUS sp.
Trametes aspera (Jungh.) Bres.

FICUS spp.
Auricularia tenuis Lév., dead branches.
Cladoderris dendritica Pers., dead branches.
Lenzites palisoti Fr., dead branches.
Leucoporus gallo-pavonis (Berk.) Pat., dead branches.
Polyporus lignosus Kl., dead branches.
Trametes aspera (Jungh.) Bres., dead branches.
Trametes persoonii Mont., dead branches.
Trametes scopulosa (Berk.) Bres., dead branches.

FICUS RELIGIOSA L.
Trametes persoonii Mont., dead branches.

FURCRAEA GIGANTEA Vent.
Auricularia auricula-judæ (L.) Schroet., dead leaves.

HERITIERA LITTORALIS Dry.
Hymenochaete perpusilla Pat., living leaves.
HEVEA BRASILIENSIS (HBK) Muell.-Arg.
Auricularia polytricha (Mont.) Sacc., dead branches.
Cladoderris dendritica Pers., dead branches.
Favolus tener Lév., dead branch.
Heterochaete tenuicula (Lév.) Pat., dead branches.
Hexagona thwaitesii Berk., dead branches.
Schizophyllum commune Fr., dead stump.
Trametes persoonii Mont., dead branches.
IPOMOEA BATATAS (L.) Poir.
Schizophyllum commune Fr., dead root.
KOORDERSIODENDRON PINNATUM Merr.
Microporus sanguineus (Lév.) Pat., dead branches.
LEUCAENA GLAUCA (L.) Benth.
Auricularia mesenterica (Dicks.) Fr., dead stump.
Auricularia tenuis Lév., dead branches.
Hexagona thwaitesii Berk., dead branches.
Hymenochaete attenuata Lév., dead branches.
Lenzites palisoti Fr., dead branches.
Lenzites tenuis Berk., dead branches.
Lycoperdon roseum Zoll., dead branches.
Microporus xanthopus (Fr.) Pat., dead branches.
Schizophyllum commune Fr., dead branches.
LITSEA sp.
Coriolus hirsutus (Fr.) Quel., dead branches.
LUFFA CYLINDRICA (Linn.) Roem.
Schizophyllum commune Fr., living stems.
MACARANGA TANARIUS (L.) Muell.-Arg.
Hexagona thwaitesii Berk., dead twig.
MALLOTUS sp.
Favolus philippinensis Berk., dead branches.
Lenzites palisoti Fr., dead branches.
Marasmius pilopus Kalchbr., dead branches.
MANGIFERA CAESIA Jack.
Coriolus hirsutus (Fr.) Quel., dead branches.
MANGIFERA INDICA L.
Auricularia polytricha (Mont.) Sacc., dead branches.
Hexagona thwaitesii Berk., dead branches.
Lenzites palisoti Fr., dead branches.
Microporus sanguineus (Lév.) Pat., dead branches.
Polyporus rugulosus Lév., dead branches.
Schizophyllum commune Fr., dead branches.
MELIACEAE indet.
Auricularia tenuis Lév., dead branches.
MEMECYLON sp.
Lycoperdon roseum Zoll., dead stem.
MORUS ALBA L.
Microporus xanthopus (Fr.) Pat., dead branches.

MUSA SAPIENTUM L.
Lenzites tenuis Berk., partly dead leaf.
Schizophyllum commune Fr., dead leaf sheath.
PARASHOREA PLICATA Brandis.
Coriolus hirsutus (Fr.) Quel., dead branches.
PARINARIUM sp.
Auricularia tenuis Lév., dead branches.
PARKIA JAVANICA (Lam.) Merr. (*P. roxburghii* G. Don).
Auricularia polytricha (Mont.) Sacc., bark of living tree.
Coriolus hirsutus (Fr.) Quel., dead branches.
Hexagona thwaitesii Berk. var. *retropicta* Bres., dead wood cuttings.
Lenzites palisoti Fr., dead bark.
Trametes badia Berk., dead trunk.
PREMNA ODORATA Blanco.
Auricularia mesenterica (Dicks.) Fr., dead branches.
PROSOPIS VIDALIANA Naves.
Lenzites applanata Fr., dead branches.
Schizophyllum commune Fr., bark.
PSIDIUM GUAJAVA L.
Auricularia tenuis Lév., dead branches.
Cyclomyces cichoriaceus (Berk.) Pat., dead branches.
Microporus xanthopus (Fr.) Pat., dead branches.
PTEROCARPUS sp.
Auricularia tenuis Lév., dead branches.
PTEROCYMBIUM TINCTORIUM Merr.
Trametes persoonii Mont., dead branches.
QUERCUS sp.
Cyclomyces tabacinus (Mont.) Pat., dead branches.
Microporus xanthopus (Fr.) Pat., dead branches.
SACCHARUM OFFICINARUM L.
Schizophyllum commune Fr., dead stems.
SAPIUM MERRILLIANUM Pax et K. Hoffm.
Schizophyllum commune Fr., dead branches.
SCHIZOSTACHYUM sp.
Schizophyllum commune Fr., dead stem.
SIPHONODON CELASTRINEUS Griff.
Heterochaete tenuicula (Lév.) Pat., dead branches.
TAMARINDUS INDICA L.
Schizophyllum commune Fr., dead branches.
TERMINALIA COMINTANA Merr.
Trametes flava (Jungh.) Pat., dead branches.
THEOBROMA CACAO L.
Auricularia mesenterica (Dicks.) Fr., dead branches.
Polyporus rugulosus Lév., dead branches.
TREMA sp.
Microporus affinis (Nees) Pat., dead branches.
ZEA MAYS L.
Schizophyllum commune Fr., dead stem.

REVIEW

A Handbook | of | Colloid-Chemistry | The recognition of colloids, the | theory of colloids, and their | general physico-chemi- | cal properties | by | Dr. Wolfgang Ostwald | Privatdozent in the University of Leipzig | second English edition | translated from the third German edition | by | Dr. Martin H. Fischer | professor of physiology in the University of Cincinnati | with numerous notes added | by | Emil Hatschek | Cass Institute, London | with 63 illustrations | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street. Cloth, pp. i–xvi + 1–284, $3.50 net.

Due principally to the rapidly increasing realization of the importance of colloid chemistry in various fields, especially in the practical applications of chemical science, the scarcity of textbooks on this subject has been felt. This new English edition of Wolfgang Ostwald's standard work will undoubtedly meet a ready reception. While not so much as might be wished has been added since 1912 (a thorough revision being impossible on account of the war), the results of some recent work, particularly of Hatschek's own researches on the physical properties of colloids, have been included.

A brief introduction includes the methods for recognition of colloids, their classification into suspensions and emulsoids, and the determination of their electric charge. Part I is a presentation of the theory of colloids, and includes chapters on their constitution, general properties, and energy relations. The present conception of colloid chemistry as a science dealing with surface-energy relations of a condition (the colloid state) which is very common, and in which any substance may be, is contrasted with the original view that the subject dealt only with a few glue-like substances. Part II takes up in detail the physical properties of colloids, such as vapor tension, viscosity, Brownian movement, and diffusibility.

The book is well suited for a text or a reference book for those whose work is related to the subject of colloids.

G. A. P.